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PROCESS CONTROLLER AND DATA MONITORING METHOD

Inventor:	Shinichi Hiramatsu Control Works, Mitsubishi Electric Corp. 1-1-2 Wadasaki-cho, Hyogo-ku, Kobe-shi
Applicant:	000006013 Mitsubishi Electric Corp. 2-2-3 Marunouchi, Chiyoda-ku, Tokyo
Agent:	Junichi Miyasono, patent attorney

[There are no amendments to this patent.]

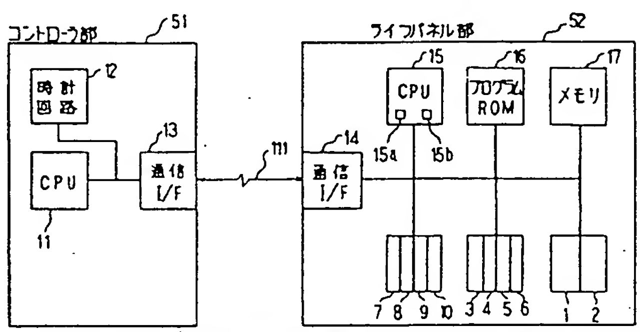
Abstract

Objective

To provide a process controller that can prevent the occurrence of problems, simplify maintenance inspection, and shorten inspection time by automatically monitoring the replacement periods of the constituent parts with a service life of the process controller.

Constitution

The use start dates and replacement periods of the constituent parts with a service life of the process controller are set by setting switch (9) and are displayed on use start date display unit (4) and replacement period display unit (6), respectively. The operating period from the use start date to the current date is calculated with calculating means (15a) and displayed on operating period display unit (5). If the operating period exceeds the replacement period, a warning signal is output from warning signal output means (15b).



1; 部品選択表示器、2; 部品寿命警告表示器、3; 現在日表示器、4; 使用開始日表示器、5; 稼働期間表示器、6; 交換周期表示器、7; 部品選択スイッチ、8; 設定項目選択スイッチ、9; 設定スイッチ、10; 設定データ変更スイッチ、15a; 計算手段、15b; 警告信号出力手段、111; 通信線

Key:

1	Part selection display unit
2	Part's service life expiration warning display unit
3	Current date replacement period
4	Use start date display unit
5	Operating period display unit
6	Replacement period display unit
7	Part selection switch
8	Set item selection switch
9	Setting switch
10	Set data changing switch
12	Clock circuit
13, 14	Communication I/F
15a	Calculating means
15b	Warning signal output means
16	Program ROM
17	Memory

51	Controller part
52	Life panel part
111	Communication line

Claims

1. A process controller characterized by the fact that the process controller used for controlling control objects is equipped with a means that can set the use start dates and the replacement periods of the constituent parts with a service life, a calculating means that is used calculate the operating period from the aforementioned use start date to the current date, a warning signal output means that can output a warning signal when the aforementioned operating period exceeds the replacement period, and a part's life data display means that displays the aforementioned use start date, operating period, replacement period, and other part's life data.

2. A data monitoring method with which a process controller used for controlling control objects is connected to a host man-machine monitoring device so that the part's life data generated in the aforementioned process controller can be monitored with the aforementioned man-machine monitoring device.

3. A data monitoring method with which a process controller used for controlling control objects is connected to a telephone line so that the part's life data generated in the aforementioned process controller can be monitored with a telephone or a facsimile machine.

4. A data monitoring method with which a process controller used for controlling control objects is connected to a programming tool so that the part's life data generated in the aforementioned process controller can be monitored with the aforementioned programming tool.

5. A process controller characterized by the fact that the process controller used for controlling control objects is equipped with a means that can set the use start dates and the replacement periods of the constituent parts with a service life, a calculating means that is used calculate the operating period from the aforementioned use start date to the current date, a warning signal output means that can output a warning signal when the aforementioned operating period exceeds the replacement period, a part's life data display means that displays the aforementioned use start date, operating period, replacement period, and other part's life data, and a part replacement history list file that stores the aforementioned part's life data.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a process controller and a data monitoring method that can be applied to a control instrumentation system used for controlling printing, etc.

[0002]

Prior art

Figure 10 shows a monitor panel for displaying the operating status of a conventional process controller in an instrumentation control system to the operator according to the Maintenance Inspection Summary of Mitsubishi General Instrumentation Control System MACTUS530 (IB-62527-A, published in June 1993). Figure 11 is a schematic oblique view of the process controller. In Figure 10, (25)-(29) represent LED display units for displaying the operating status of the process controller. More specifically, (25) represents a serious problem LED display unit; (26) represents a light problem LED display unit; (27) represents a CPU power supply abnormality LED display unit; (28) represents an I/O power supply abnormality LED display unit; and (29) represents a low-battery LED display unit. (30) is a logic diagram illustrating the cause of the serious problems, and (31) is a logic diagram illustrating the cause of the light problems.

[0003]

The operation will be explained below. The operator of the process controller determines whether the instrumentation control system works properly or is experiencing some problems by monitoring serious problem LED display unit (25) and light problem LED display unit (26). Each of LED display units (25)-(29) is turned on when the system works properly and is turned off when an abnormality occurs.

[0004]

When serious problem LED display unit (25) is turned off, it means that a serious problem occurs in the process controller. Subsequently, the cause of the serious problem is traced by using logic diagram (30), and the abnormal part is specified. For example, if CPU power supply abnormality LED display unit (27) and I/O power supply abnormality LED display unit (28) are turned off, it means that the abnormal parts are the CPU power supply and I/O power supply where the serious problem of the system occurs. Then, the process controller is stopped, and the broken CPU power supply and I/O power supply are replaced to recover the instrumentation control system.

[0005]

Similarly, if light problem LED display unit (26) is turned off, it means that a light problem occurs in the process controller. The cause of the light problem is traced by using logic diagram (31), and the abnormal part is specified. For example, if low-battery LED display unit (29) is turned off, it becomes necessary to replace the battery with a new one because the battery power is low.

[0006]

Problems to be solved by the invention

Since the monitor panel of the conventional process controller has the aforementioned configuration, it is possible to determine whether each part is normal or abnormal. However, it is impossible to determine whether a part has reached its service life limit and needs to be replaced by simply observing the monitor panel. The operator must prepare a part replacement table periodically and confirms the part replacement period according to this table. This is inconvenient.

[0007]

The purpose of the present invention is to solve the aforementioned problem by providing a process controller that can prevent the occurrence of problems, simplify maintenance inspection, and shorten inspection time by automatically monitoring the replacement periods of the parts of the process controller with a service life.

[0008]

Means to solve the problems

The process controller disclosed in the first part of the present invention is equipped with a setting means (setting switch (9)) that can set the use start dates and the replacement periods of the constituent parts with a service life, a calculating means (15a) that is used calculate the operating period from the aforementioned use start date to the current date, a warning signal output means (15b) that can output a warning signal when the aforementioned operating period exceeds the replacement period, and part's life data display means (use start date display unit (4), operating period display unit (5), and replacement period display unit (6)) which displays the aforementioned use start date, operating period, replacement period, and other part's life data.

[0009]

The data monitoring method disclosed in the second part of the present invention is characterized by the fact that a process controller P used for controlling control objects is connected to a host man-machine monitoring device (18) so that the part's life data generated in the aforementioned process controller P can be monitored with said man-machine monitoring device (18).

[0010]

The data monitoring method disclosed in the third part of the present invention is characterized by the fact that a process controller P used for controlling control objects is connected to a telephone line (95) so that the part's life data generated in the aforementioned process controller P can be monitored with a telephone (92) or a facsimile machine (93).

[0011]

The data monitoring method disclosed in the fourth part of the present invention is characterized by the fact that a process controller P used for controlling control objects is connected to a programming tool (20) so that the part's life data generated in the aforementioned process controller P can be monitored with said programming tool (20).

[0012]

The process controller disclosed in the fifth part of the present invention is equipped with a setting means (setting switch (9)) that can set the use start dates and the replacement periods of the constituent parts with a service life, a calculating means (15a) that is used calculate the operating period from the aforementioned use start date to the current date, a warning signal output means (15b) that can output a warning signal when the aforementioned operating period exceeds the replacement period, a part's life data display means (use start date display unit (4), operating period display unit (5), and replacement period display unit (6)) that displays the aforementioned use start date, operating period, replacement period, and other part's life data, and a part replacement history list file (23) that stores the aforementioned part's life data.

[0013]

Operation

For the process controller disclosed in the first part of the present invention, the use start dates and replacement periods of the constituent parts with a service life are set by setting means (setting switch (9)), and the operating periods from the use start dates to the current date are calculated with calculating means (15a). Also, the use start dates, replacement periods, and

operating periods are displayed on the part's life data display means (use start date display unit (4), replacement period display unit (6), and operating period display unit (5)). If the operating period exceeds the replacement period, a warning signal will be output from warning signal output means (15b).

[0014]

In the data monitoring method disclosed in the second part of the present invention, the part's life data generated by process controller P are sent to host man-machine monitoring device (18) so that they can be monitored by host man-machine monitoring device (18).

[0015]

In the data monitoring method disclosed in the third part of the present invention, the part's life data generated by process controller P are sent to telephone (92) or facsimile machine (93) through a telephone line (95). In this way, the part's life data can be monitored with telephone (92) or facsimile machine (93).

[0016]

In the data monitoring method disclosed in the fourth part of the present invention, part's life data generated by process controller P are sent to programming tool (20) so that they can be monitored by programming tool (20).

[0017]

For the process controller disclosed in the fifth part of the present invention, the use start dates and replacement periods of the constituent parts with a service life are set by setting means (setting switch (9)), and the operating periods from the use start dates to the current date are calculated with calculating means (15a). Also, the use start dates, replacement periods, and operating periods are displayed on the part's life data display means (use start date display unit (4), replacement period display unit (6), and operating period display unit (5)). If the operating period exceeds the replacement period, a warning signal will be output from warning signal output means (15b). Also, the part's life data are stored in part replacement history list file (23).

[0018]

Application examples

<u>Application Example 1</u>

In the following, Application Example 1 of the present invention will be explained with reference to the figures. Figure 1 is a block diagram illustrating the configuration of the process

controller disclosed in Application Example 1 of the present invention. In Figure 1, controller part (51) is equipped with CPU (11), clock circuit (12), and communication interface (communication I/F) (13). Service life panel part (52) is equipped with communication interface (14), CPU (15), program ROM (16), memory (17), part selection display unit (1), part's service life expiration warning display unit (2), current date display unit (3), use start date display unit (part's life data display means) (4), operating period display unit (part's life data display means) (5), replacement period display unit (part's life data display means) (6), part selecting switch (7), set item selecting switch (8), setting switch (setting means) (9), and set data changing switch (10). Said display units (1) and (2) are realized with LED, while said display units (3)-(6) are realized with English numeral LEDs. Controller part (51) and life panel part (52) are connected to each other via communication line (111). Setting switch (9) in said life panel part (52) is a setting means that can set the use start dates and replacement periods of the parts with a service life, such as power supply device, fan, filter, and battery (not shown in the figure) in the process controller. CPU (15) is equipped with calculating means (15a), which calculates the operating period of each part from the use start date to the current date, and warning signal output means (15b) which can output a warning signal if the aforementioned operating period exceeds the replacement period. Figure 2 is a schematic diagram illustrating the appearance of display panel (53) on said life panel part (52). As described above, display panel (53) is equipped with part selection display unit (1), part's service life expiration warning display unit (2), current display unit (3), use start date display unit (4), operating period display unit (5), replacement period display unit (6), part selecting switch (7), set item selecting switch (8), setting switch (9), and set data changing switch (10).

[0019]

CPU (15) in life panel part (52) shown in Figure 1 controls part selection display unit (1), part's service life expiration warning display unit (2), current display unit (3), use start date display unit (4), operating period display unit (5), replacement period display unit (6), part selecting switch (7), set item selecting switch (8), setting switch (9), and set data changing switch (10). Program ROM (16) stores a program used for the control of CPU (15). Memory (17) stores the use start dates, operating periods, replacement period, etc. of the parts. In order to recognize the current date, life panel part (52) communicates with CPU (11) of controller part (51) via communication interfaces (13) and (14) and communication line (111) and reads out the time of clock circuit (12) of controller part (51).

[0020]

The display contents and the operating method of display panel (53) shown in Figure 2 will be explained below. In the process controller, the parts whose service lives are to be confirmed are selected by part selecting switch (7). At present, the corresponding part selection display units (1) are turned on in accordance with the parts selected. The use start date and operating period of each part are displayed on use start date display unit (4) and operating period display unit (5). The operating period displayed on operating period display unit (5) is obtained by subtracting the use start date displayed on use start date display unit (4) from the current date displayed on current date display unit (3). Thus, it is possible to confirm how long the part has been used. Also, the replacement period of the part is displayed on replacement period display unit (6). According to the contents of operating period display unit (5) and replacement period display unit (6), it is possible to confirm how much longer the part can be used. The operating period is calculated by operating period calculating means (15a). If the operating period displayed on operating period display unit (5) exceeds the replacement period displayed on replacement period display unit (6), it means that it is time to replace the part. The part's service life expiration warning display unit (2) is turned on with a warning signal sent from warning signal output means (15b) to inform the operator that it is time to replace the part. The contents of current date display unit (3), use start date display unit (4), and replacement period display unit (6) can be changed on the life display panel. To change the display contents, the items to be changed are first selected by set item selecting switch (8). Then, the values of the data are changed with set data changing switch (10). After the changes are made, the changed contents are registered by pressing setting switch (9).

[0021]

The operation of CPU (15) of life panel part (52) will be explained below with reference to the flow chart shown in Figures 3-5. First, the flow chart of Figure 3 shows the display processing of part's service life expiration warning display unit (2). CPU (15) of life panel part (52) reads out the time of clock circuit (12) in controller part (51) through communication interface (14) to recognize the current date (step ST1). Then, the use start date is read from memory (17) (step ST2). The use start date is subtracted from the current date to calculate the operating period which is then stored in memory (17) (step ST3). The replacement period is then read from memory (17) and compared with the operating period (step ST4). If the operating period exceeds the replacement period, part's service life expiration warning display unit (2) is turned on (step ST5). The process from step ST2 to step ST5 is carried out for all of the parts (step ST6).

[0022]

Subsequently, the flow chart of Figure 4 shows the set changing process for the current date, use start date, and replacement period. First, it is confirmed whether the current has been changed (step ST7). If there is a change, time (12) of clock circuit (12) in controller part (51) is corrected (step ST8). Then, the part selected by part selecting switch (7) is recognized (step ST9). It is then confirmed whether the use start date and replacement period are changed (step ST10 and ST12). If they are changed, the contents concerned with the use start date and replacement period stored in memory (17) are changed (step ST11 and step ST13).

[0023]

Subsequently, the flow chart of Figure 5 shows the display processing of each of display units (3)-(6). Current data display unit (3) reads out and displays the time of time clock (12) in controller part (51) (step ST14). After the part selected by part selecting switch (7) is recognized (step ST15), the use start date, operating period, and replacement period are displayed on use start date display unit (4), operating period display unit (5), and replacement period display unit (6) by reading the contents of the corresponding part from memory (17) (step ST16).

[0024]

Application Example 2

In said Application Example 1, display panel (53) comprises display units (1) and (2) made up of LED, display units (3)-(6) made of English numeral LEDs, and switches (7)-(10). In Application Example 2, however, as shown in Figure 6, it is also possible to use liquid-crystal touch panel display device (61). In this way, the device can be further miniaturized, while the same effect as that of said Application Example 1 can be realized.

[0025]

Application Example 3

In said Application Examples 1 and 2, the life panel part of the process controller must be operated by an operator to confirm the service lives of the parts. However, as shown in Figure 7, the life data of each part stored in the life panel part can also be displayed on a host man-machine monitoring device (18) via a system bus (71) to confirm the status of the parts with a service life for each of process controllers P1-Pn. It is also possible to use a telephone line (74) to automatically ring a telephone (72) or to use a FAX (facsimile) machine (19) at the permanent address of the operator when the service life of a part expires. In this way, the parts of process controllers P1-Pn with a service life can be monitored remotely. It is also possible to connect process controllers P1-Pn to a programming tool (20) to display the service life data via

communication interface (75). In this way, process controllers P1-Pn can be monitored while they are being adjusted.

[0026]

Application Example 4

In said Application Examples 1, 2, and 3, only service lives are displayed. As described in Application Example 4, however, the part replacement history can be printed out with a printer, which is connected to a host man-machine monitoring device or a programming tool, and stored as a document.

[0027]

Figure 8 is a block diagram illustrating the configuration of a system including a process controller disclosed in Application Example 4 of the present invention. In Figure 8, the same reference numbers are assigned to the parts equivalent to those shown in Figure 1, respectively, and the explanation for these parts is omitted. In Figure 8, controller part (51) of process controller P is also equipped with part replacement history file (23) which stores the part's life data generated in life panel part (52), system bus interface (82) which acts as the interface with host man-machine monitoring device (18), telephone line interface (81) which acts as the interface with telephone line (95) connected to telephone (92) or facsimile machine (93), and programming tool interface (83) which acts as the interface with programming tool (20) in addition to CPU (11), clock circuit (12), and communication interface (13) which are also used in Application Example 1. Host man-machine monitoring device (18) is equipped with system bus interface (84) which acts as the interface with controller part (51), part replacement history file (24) which stores the part's life data sent from controller part (51), CRT interface (86) which acts as the interface with CRT (90), keyboard interface (87) which acts as the interface with keyboard (91), printer interface (88) which acts as the interface with printer (21), and CPU (85) which controls the aforementioned constituent elements. Host man-machine monitoring device (18) and controller part (51) are connected via system bus (94). Printer (22) is connected to programming tool (20).

[0028]

The operation will be explained below. The part replacement contents generated in life panel part (52) are stored as a part replacement history list, such as the one shown in Figure 9, in part replacement history file (23) in controller part (51) through communication interface (14), communication line (111), and communication interface (13). The part's life data are also stored as a part replacement history list in part replacement history file (24) of host man-machine

monitoring device (18) through system bus interface (82), system bus (94), and system bus interface (84). When the part's life data stored in part replacement history file (23) of controller part (51) are sent to programming tool (20), the part replacement history list can be printed by printer (22) and output. Also, when the part's life data are sent to telephone (92), an alarm can be generated. When the part's life data are sent to facsimile machine (93), the replacement history list can be printed and output. When the part's life data stored in part replacement history file (24) of host man-machine monitoring device (18) are sent to printer (21), the part replacement history list can be printed and output. Since the content of part replacement history file (24) is displayed on CRT (90), the content can be amended by operating keyboard (91). Since the part replacement history list used in Application Example 4 can be generated automatically, the maintenance inspection performed by the operator can be simplified, and the time can be shortened.

[0029]

Effects of the invention

As explained above, the process controller disclosed in the first part of the present invention is equipped with a setting means which can set the use start dates and replacement periods of the constituent parts with a service life, a calculating means that can calculate the operating period from the use start date to the current date, a warning signal output means that can output a warning signal when the aforementioned operating period exceeds the replacement period, and a part's life data display means which can display the aforementioned use start dates, operating periods, replacement period, and other part's life data. Consequently, the times for replacing the parts of the process controller with a service life can be detected automatically and confirmed easily. In this way, the problems can be prevented before they occur. Also, the maintenance inspection operation can be simplified, and the inspection time can be shortened.

[0030]

According to the second part of the present invention, a process controller used for controlling control objects is connected to a host man-machine monitoring device so that the part's life data generated in the aforementioned process controller can be monitored by the aforementioned man-machine monitoring device. Consequently, the times for replacing the parts of the process controller with a service life can be monitored from a central monitoring room. In this way, problems can be prevented before they occur. Also, the maintenance inspection operation can be simplified, and the inspection time can be shortened.

[0031]

According to the third part of the present invention, a process controller used for controlling control objects is connected to a telephone line so that the part's life data generated in the aforementioned process controller can be monitored via telephone or a facsimile machine. Consequently, the times for replacing the parts of the process controller with a service life can be monitored remotely. In this way, problems can be prevented before they occur. Also, maintenance inspection can be simplified, and the inspection time shortened.

[0032]

According to the fourth part of the present invention, a process controller used for controlling control objects is connected to a programming tool so that the part's life data generated in the aforementioned process controller can be monitored with the aforementioned programming tool. Consequently, the times for replacing the parts with a service life can be monitored while the process controller is being adjusted. In this way, problems can be prevented before they occur. Also, the maintenance inspection operation can be simplified and the inspection time shortened.

[0033]

The process controller disclosed in the fifth part of the present invention is also equipped with a part replacement history list file which stores the part's life data in addition to the setting means, calculating means, warning signal output means, and the part's life data display means of the process controller disclosed in the first part of the present invention. Consequently, the same effects as those of the first part of the present invention can be realized, and the part replacement history list can be output. In this way, the maintenance inspection operation can be further simplified and carried out in a shorter period of time.

Brief description of the figures

Figure 1 is a block diagram illustrating the configuration of the process controller disclosed in Application Example 1 of the present invention.

Figure 2 is a diagram illustrating the display panel used in Application Example 1.

Figure 3 is a flow chart illustrating the service life expiration warning output processing in Application Example 1.

Figure 4 is a flow chart illustrating the set changing processing in Application Example 1.

Figure 5 is a flow chart illustrating the panel display processing in Application Example 1.

Figure 6 is a diagram illustrating the appearance of the liquid-crystal touch panel display device disclosed in Application Example 2 of the present invention.

Figure 7 is a diagram illustrating a system including the process controller disclosed in Application Example 3 of the present invention.

Figure 8 is a block diagram illustrating the configuration of a system including the process controller disclosed in Application Example 4 of the present invention.

Figure 9 is a diagram illustrating the part replacement history list in Application Example 4.

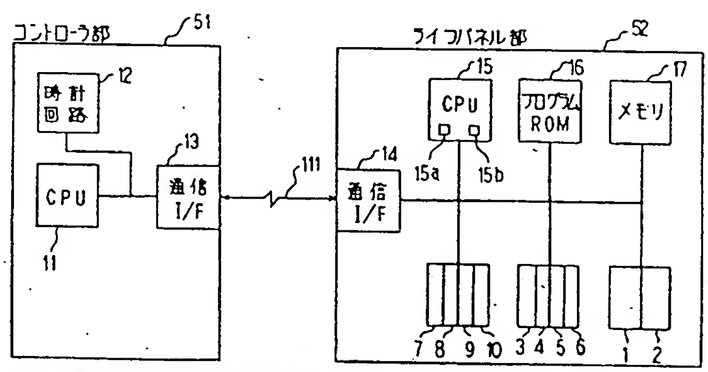
Figure 10 is a diagram illustrating the monitor panel of a conventional process controller.

Figure 11 is a schematic oblique diagram illustrating a conventional process controller.

Explanation of symbols

1	Part selection display unit
2	Part's service life expiration warning display unit
3	Current date display unit
4	Use start date display unit (part's life data display means)
5	Operating period display unit (part's life data display means)
6	Replacement period display unit (part's life data display means)
7	Part selecting switch
8	Set item selecting switch
9	Setting switch (setting means)
10	Set data changing switch
11, 15, 85	CPUs
12	Clock circuit
13, 14, 75	Communication interfaces
16	Program ROM
17	Memory
18	Host man-machine monitoring device
20	Programming tool
21, 22	Printers
23, 24	Part replacement history files
25	Serious problem LED display unit
26	Light problem LED display unit
27	CPU power supply LED display unit
28	I/O power supply LED display unit
29	Low-battery LED display unit

30	Serious problem logic diagram
31	Light problem logic diagram
51	Controller part
52	Life panel part
53	Display panel
61	Liquid-crystal touch panel display device
P, P1, Pn	Process controllers
71, 94	System buses
72, 92	Telephones
73, 93	Facsimile machines
74	Telephone line
81	Telephone line interface
82, 84	System bus interfaces
83	Programming tool interface
86	CRT interface
87	Keyboard interface
88	Printer interface
90	CRT
91	Keyboard
111	Communication line



1; 部品選択表示器、2; 部品寿命警告表示器、3; 現在日表示器、4; 使用開始日表示器.
5; 稼働期間表示器、6; 交換周期表示器、7; 部品選択スイッチ、8; 設定項目選択スイッチ.
9; 設定スイッチ、10; 設定データ変更スイッチ、15a; 計算手段、15b; 警告信号出力手段.
111; 通信線

Figure 1

Key:

1	Part selection display unit
2	Part's service life expiration warning display unit
3	Current date replacement period
4	Use start date display unit

5 Operating period display unit
6 Replacement period display unit
7 Part selection switch
8 Set item selection switch
9 Setting switch
10 Set data changing switch
12 Clock circuit
13, 14 Communication I/Fs
15a Calculating means
15b Warning signal output means
16 Program ROM
17 Memory
111 Communication line
51 Controller part
52 Life panel part

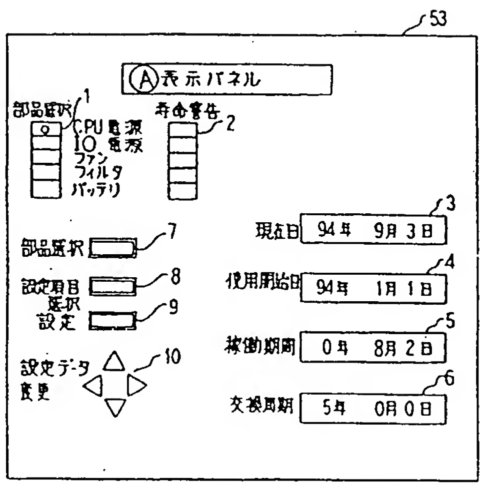


Figure 2

Key:
A Display panel
1 Part selection
CPU power supply
I/O power supply
Fan
Filter
Battery
2 Service life expiration warning
3 Current date: September 3, 1994
4 Use start date: January 1, 1994
5 Operating period: 8 months and 2 days
6 Replacement period: 5 years
7 Part selection
8 Set item
9 Setting

10 Set data change

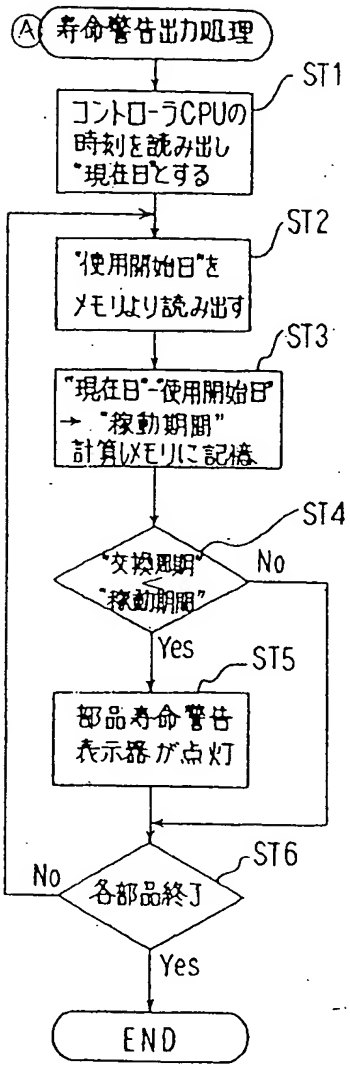


Figure 3

Key:
- A Service life expiration warning output processing
- ST1 The time of the controller CPU is read out and taken as the "current date."
- ST2 The "use start date" is read out from the memory.
- ST3 "Current date" - "use start date" -> "operating period" is calculated and stored in the memory.
- ST4 "Replacement period" < "operating period"
- ST5 The part's service life expiration warning display unit is turned on.
- ST6 Completed for all the parts?

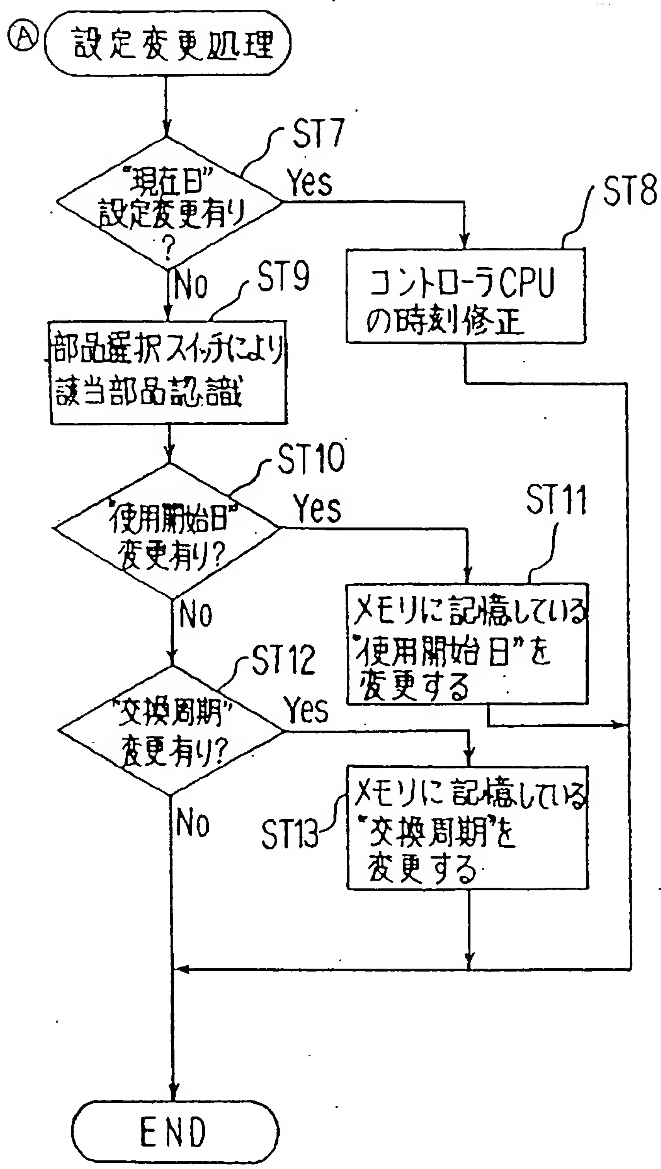


Figure 4

Key:	A	Set changing processing
	ST7	Is the "current date" changed?
	ST8	Correct the time of the controller CPU
	ST9	The corresponding part is recognized by the part selecting switch.
	ST10	Is the "use start date" changed?
	ST11	The "use start date" stored in the memory is changed.
	ST12	Is the "replacement period" changed?
	ST13	The "replacement period" stored in the memory is changed.

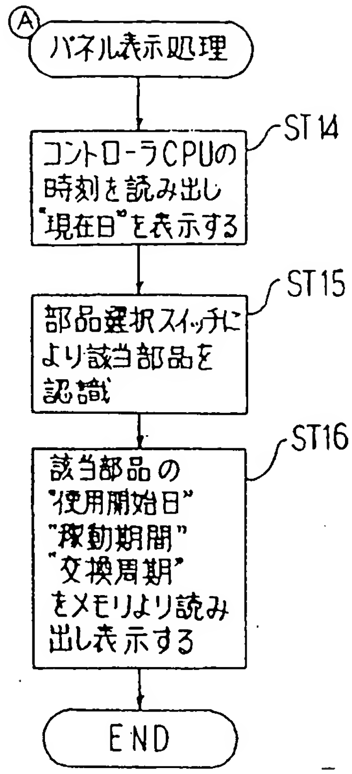


Figure 5

Key: A Panel display processing
ST14 The time of the controller CPU is read out, and the "current date" is displayed.
ST15 The corresponding part is recognized by the part selecting switch.
ST16 The "use start date," "operating period," and "replacement period" of the corresponding part are read out from the memory and displayed.

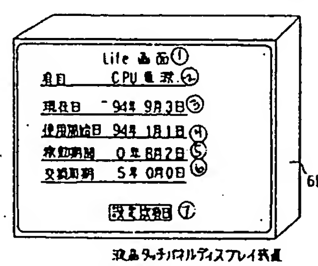
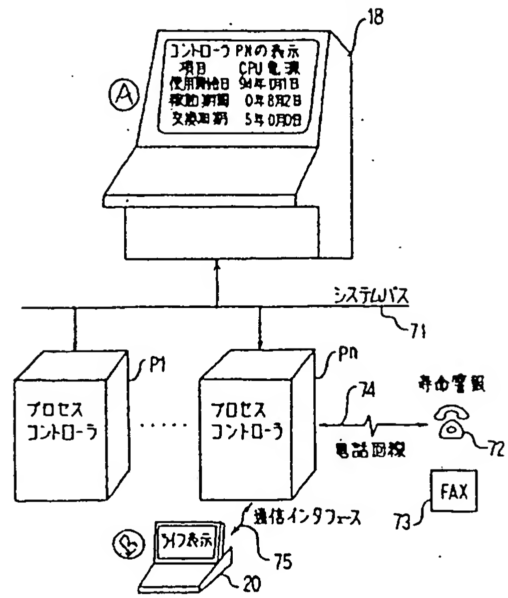


Figure 6

Key: 1 Life picture
2 Item: CPU power supply
3 Current date: September 3, 1994
4 Use start date: January 1, 1994
5 Operating period: 8 months and 2 days
6 Replacement period: 5 years

7 Set Next item
61 Liquid-crystal touch panel display device



18; 上位マンマシン監視装置
20; プログラム作成ツール

Figure 7

Key:
A Display of controller PN
Item: CPU power supply
Use start date: January 1, 1994
Operating period: 8 months and 2 days
Replacement period: 5 years
B Life display
P1 Process controller
Pn Process controller
18 Host man-machine monitoring device
20 Programming tool
71 System bus
72 Service life warning
74 Telephone line
75 Communication interface

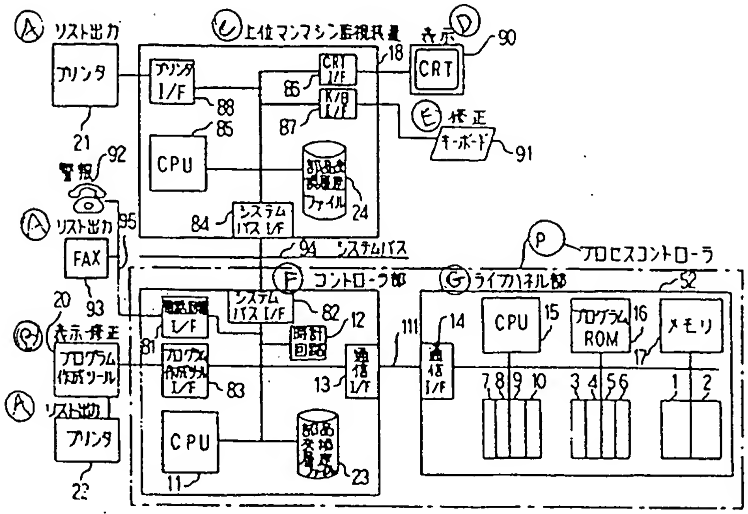


Figure 8

Key:		
	A	List output
	B	Display/amendment
	C	Host man-machine monitoring device
	D	Display
	E	Amendment
	F	Controller part
	G	Life panel part
	P	Process controller
	12	Clock circuit
	13	Communication I/F
	14	Communication I/F
	16	Program ROM
	17	Memory
	20	Programming tool
	21	Printer
	22	Printer
	23	Part replacement history file
	24	Part replacement history file
	81	Telephone line I/F
	82	System bus I/F
	83	Programming tool I/F
	88	Printer I/F
	84	System bus I/F
	91	Keyboard
	92	Alarm
	94	System bus

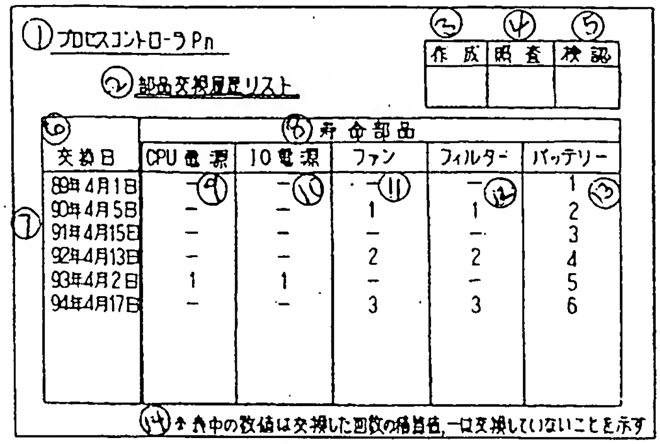


Figure 9

Key:
1 Process controller Pn
2 Part replacement history list
3 Preparation
4 Verification
5 Confirmation
6 Replacement date
7 April 1, 1989
April 5, 1990
April 15, 1991
April 13, 1992
April 2, 1993
April 17, 1994
8 Parts with a service life
9 CPU power supply
10 I/O power supply
11 Fan
12 Filter
13 Battery
14 The values in the table are the accumulated times of replacement, and—means no replacement is made.

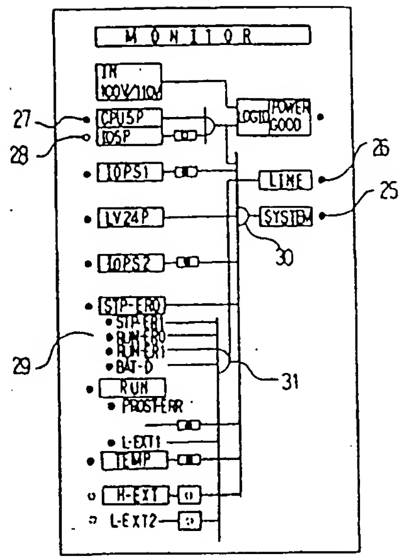


Figure 10

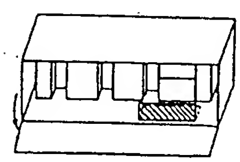


Figure 11

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14(1991)September, No.3, New York, US

CEPT—A Computer-Aided Manufacturing Application for Managing Equipment Reliability and Availability in the Semiconductor Industry

p. 499 - 506

Prasad Rampalli, *Member, IEEE,* Arakere Ramesh, and Nimish Shah

Abstract—Historically, the semiconductor industry has been extremely capital intensive with terrible process equipment utilization rates. The industry is highly competitive and is continuously striving for faster device performance leading to rapidly shrinking (less than 1 μm) chip geometries. These rapid technology changes demand introduction of more accurate and high resolution equipment leading to escalated capital costs with low reliability. Net result: manufacturing cost containment becomes a challenge!

A comprehensive equipment performance management system becomes a vital tool to focus on opportunities to better utilize equipment in a competitive environment. Recognizing this need, Intel has embarked on an aggressive ten man-year computer system development and deployment effort to improve equipment utilization at all its manufacturing facilities. This article discusses the features of the equipment management system and the joint effort by Sematech and Intel to develop an equipment performance analysis system that lay the foundation for an industry-wide standard for the first time.

I. Introduction

In the 1970's, the semiconductor industry thrived on technological innovations. Since it was a growth industry, demand was ahead of supply. Most semiconductor companies ran their manufacturing shops akin to laboratories and enjoyed high profit margins. The situation today is quite different. To survive in the 1990's, semiconductor companies must reduce die manufacturing costs and strive for high product quality.

What are the impediments to meeting the goal of reduced die manufacturing costs? With wafer fabrication moving to submicrometer technology, the cost of the equipment has gone up considerably. Couple this with an inherently low equipment utilization rate and poor reliability in the industry, manufacturing cost reduction and quality improvement become major challenges.

In a complex manufacturing scenario, the use of a standard corporate wide equipment data acquisition and management system to improve reliability, availability, and maintainability of equipment is a definite competitive advantage. This paper describes Intel's efforts to define, design, develop, and implement such a system. The equipment management system was layered on top of the computer-aided manufacturing (CAM) system, WORKSTREAM,™ used in the company.

A key by-product of the equipment performance management system introduction is a vastly improved user interface to WORKSTREAM.

Application migration in a rapidly changing distributed architecture and integration with expert systems and station controllers is given a brief treatment.

II. Project Approach

After establishing the need for an equipment performance management system, Intel analyzed two scen... to determine the platform for development...

1) proliferate a ...
2) layer the ... system on the CA...

A *total-cost* ... oped. Factors considere...

Orig'l 8 pages

- development ...
- pilot costs;
- proliferation c...
- product support
- short and long ... architecture implications on the CAM system.

The model showed that the stand-alone system was 1.75 times costlier than an integrated layered application on the CAM system. This was primarily due to the high cost of productizing a stand-alone system and the associated support through its life cycle. The stand-alone system required development of a number of interfaces to other shop floor control applications. Production support for the stand-alone system was more as support personnel were needed for both the stand-alone system and the CAM system. Figs. 1 and 2 summarize the results of the *total cost* model.

III. Computer-Aided Manufacturing (CAM)

The primary purpose of earlier generation CAM systems was to provide a data base for managing work in process

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The authors are with the Intel Corporation, Chandler, AZ 85226.
IEEE Log Number 9101108.

™WORKSTREAM is a product of Consilium Inc., Mountain View, CA.

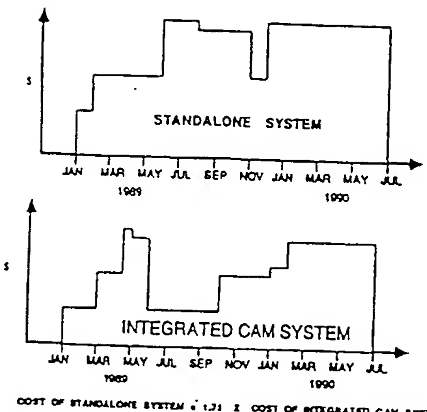

Fig. 1. Comparison of nonrecurring cost.

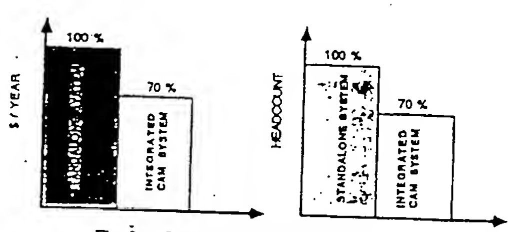

Fig. 2. Comparison of recurring cost.

(WIP). The CAM system provided engineers a window into the behavior of the manufacturing process. This was achieved via engineering data gathered at various steps of the manufacturing process. However, such a system solves only part of the problems associated with manufacturing. A comprehensive CAM system that can correlate WIP information with equipment data can provide the following benefits.

- Tracing yield losses to specific equipment.
- Tracking equipment performance (productive, idle, down).
- Ensuring that a proper recipe is being used on the machine, before a lot is processed to prevent misprocessing.
- Allowing only personnel trained on the specific equipment to process products.
- Preventing processing of products in the event of statistical process control violations of critical equipment parameters.
- Tracking equipment output (number of units processed).
- Scheduling preventive maintenance (PM) based on equipment usage (wafers processed, runs completed, etc.).

Fig. 3 illustrates the model of a typical CAM system. The model shows only the core modules of the system.

IV. Requirements for an Equipment Management System

During the requirements definition phase, Intel reviewed the capabilities of local equipment management systems. Several equipment engineers at Intel facilities were interviewed. The study showed that the user community required the following key capabilities:

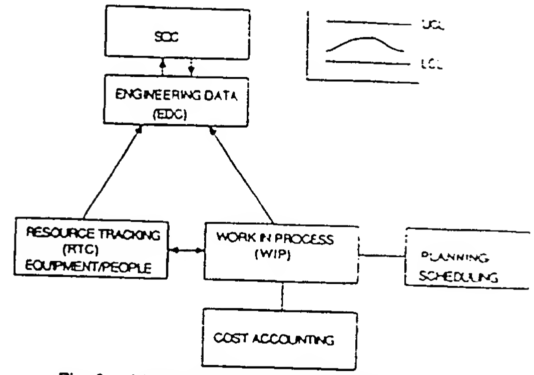

Fig. 3. Model of WORKSTREAM core modules.

- equipment failure/performance data collection;
- equipment monitor-data collection with capability to attach statistical process control charts;
- management of scheduled activity on equipment (example: PM);
- paper reduction through elimination of equipment communication log books, data collection forms, etc;
- paperless tool to manage statistical process control rule violations;
- user friendly module to analyze equipment failure/performance data (MTBF, MTTR, MWBF, etc.).

Four new modules were integrated into WORKSTREAM to meet the requirements of a corporate wide equipment management system. Several enhancements to the standard WORKSTREAM modules were implemented. Also, an equipment performance analysis module was developed.

Fig. 4 shows an overview of the equipment performance management system model. The following are the four new modules integrated into WORKSTREAM.

1) The custom data collection (CDC) module helps to gather equipment failure data in a structured manner and also provides a friendly user interface to gather equipment monitor data.
2) PM-checklist data collection module allows the user to collect checklist data during preventive maintenance.
3) The schedule-messages module displays warning messages to the user on upcoming scheduled activities.
4) The alarm-management module allows the user to manage statistical process control rule violations.

V. Equipment Failure/Monitor Data

To perform reliability analysis, any equipment reliability improvement system must provide a structured mechanism for collecting repair/breakdown information. Also, the system should allow the operators/technicians to enter raw data and automatically perform complex calculations based on user defined formulas.

The CDC module allows equipment engineers to define equipment in terms of its subsystem and sub-subsystem as illustrated in Fig. 5. Verbs are defined describing the action taken by technicians to rectify a failure. Breakup of the

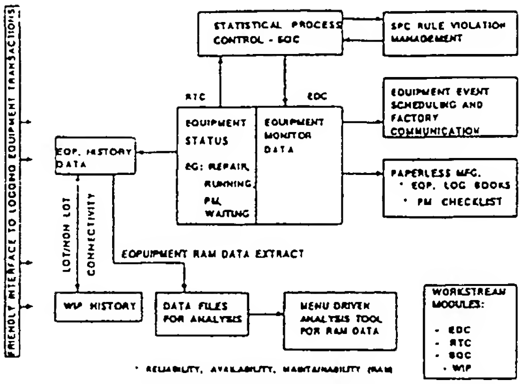

Fig. 4. Equipment performance/failure management overview model.

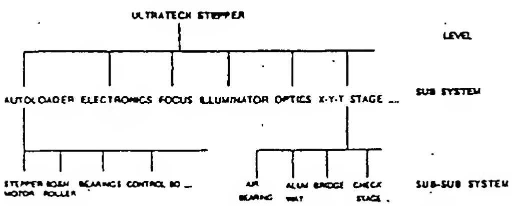

Fig. 5. Equipment classification for failure data collection.

equipment is stored in a table, which is part of the general table system (GTS) in WORKSTREAM.

How does one gather equipment failure data? When a technician logs a transaction at the completion of a repair, three screens are displayed in sequence. In the first screen, the technician makes a choice from a list of action verbs. In the second and third screen, the technician selects the subsystem (Autoloader, etc.) and the sub-subsystem (Bearing, Control Board, etc.), respectively. Capability exists to collect up to four levels of equipment failure data. The tool to analyze equipment failure data will be discussed in a later section.

Another important feature of the CDC module is the capability to customize a screen for gathering equipment monitor data. It serves the following objectives: 1) minimizes manual computations done by operators; 2) eliminates paper data collection forms from the floor; and 3) validates data entry.

Collecting data for a large sample size can be very cumbersome. To ease data entry, design of the screen layout becomes very important.

An engineer can define the screen layout for equipment monitor data collection using a forms management system (FMS™). This customized screen is integrated into WORKSTREAM and is displayed at the time of data collection.

Several complex data collection screens have been designed and implemented across the company. Fig. 6 illustrates one such application. In the illustrated example, an operator will enter the focus measurements. Based on a formula, the system will display if any focus adjustment has to be made on the Ultratech Stepper.

Statistical process control charts can be attached and displayed with control limits for equipment monitor data. To

™FMS is a product of Digital Equipment Corp.

CPT101S ENGINEERING DATA COLLECTION 06/20/90 12:00:00

UT FOCUS

LOCATION	READING
-10 , 0	1
10 , 0	1
0 , 10	-1

ADJUSTMENT REQUIRED : YES

Fig. 6. Example of engineering data collection.

prevent wafer processing on the equipment, in case of critical equipment monitors violating SPC rules, the equipment can be placed in a "DOWN" state.

VI. Factory Communication

For the smooth running of a facility communication between operators, technicians, supervisors, and engineers, regarding the current operational state and future scheduled downtimes of equipment, is vital.

Functionality was incorporated within WORKSTREAM to provide a snapshot of the current state of all machines in any given functional area of the factor. Information displayed includes:

- current equipment state (repair, waiting for parts, etc.);
- failure mode of the equipment;
- name of the technician fixing the equipment;
- date and time of an upcoming PM.

In practice, display monitors are placed in each functional area of the shop floor. Fig. 7 shows a monitor screen as displayed in a functional area.

A. Event Schedule Management

In any given facility, several types of events are scheduled to be performed on equipment. Events include:

- calender-based PM (monthly PM, annual PM, etc.);
- usage-based PM (500 run PM, 40 run chamber clean, etc.);
- events triggered due to equipment monitor data violations.

Managing the schedules of all events manually, has the following limitations:

- paper has to be used for communication;
- poor visibility into performance of events against schedule;
- schedules not accessible to all in a timely manner;
- requires a dedicated person to maintain the schedules;
- equipment usage counters (number of runs, number of wafers) have to be maintained on paper.

Such manual systems were prevalent at various facilities.

In order to overcome the limitations of a manual system, the event scheduler of WORKSTREAM was adopted. Only calendar-based events were scheduled by the scheduler. To ensure visibility and high effectiveness of the schedules, the equipment was placed in a "DOWN" state, if any event was

RTC FLEXIBLE MONITOR BOARD - DISPLAY SCREEN (NFMB) SYS 6/20/90 02:00:00

FAB PRODUCTION FAB PAGE_ 1

FUNCTIONAL AREA: LITHO

SEL	MACHINE	AVAIL	USAGE	FAILURE MODE	LAST EVENT D/T		LAST OPER	NEXT EVENT	SCHED D/T	
	DP01A	DOWN	IN REPAIR	SPIN PROB	6/20/90	00:37:00	SMITH	BIMONTHLY	7/05/90	00:00:00
	DP03B	DOWN	WAITING EQE	BAD DEVLP	6/20/90	01:30:11	JOHN	ANNUAL PM	7/06/90	00:00:00
	SU01	DOWN	WAITING ENG	MISSTEP	6/19/90	23:23:00	JAMES	WEEKLY PM	6/23/90	23:30:00
	SU16	DOWN	IN REPAIR	SCRATCHES	6/20/90	00:42:00	JOE	WEEKLY PM	6/16/90	00:00:00

Fig. 7. Display of current state of machines in a functional area.

overdue. This prevented wafer processing on the equipment, until the scheduled event was performed (e.g., PM).

B. Event Schedule Communication

Communication of scheduled events to personnel operating a machine serves two purposes. First, it provides the visibility of upcoming events, so that they get done on time to prevent any yield losses and unscheduled downtime. Secondly, it allows supervisors and engineers to plan for scheduled down time without interrupting the flow of WIP.

How do we communicate the schedule to the user? Communicating via a report turns out to be ineffective. The users need to be warned ahead of time on upcoming events that need attention. The schedule-messages module has the capability to provide the warning message.

What is a good place to display warning messages? A user performs certain transactions on an equipment on a regular basis. Such transactions include: viewing equipment history, viewing equipment definition, changing the state of equipment, etc. When the user is at a station performing a transaction, a warning message is displayed. The message includes warnings on all upcoming events for the equipment under consideration. The following is the format of warning messages displayed to the user:

- "500 wafer-PM is due in 20 wafer(s);"
- "160 run chamber-clean is due in 10 run(s);"
- "Monthly PM is due in 12 h and 15 min."

The schedule-messages module allows the definition of triggering conditions for the display of warning messages. The module can be configured, such that warning messages can be displayed while performing selected transactions on equipment. Finally, the user is allowed to inquire about all existing warning messages for a functional area.

VII. Paperless Manufacturing

Paper, one of the sources of particle generation in the fabrication facility (clean room), needs to be eliminated at all costs. Paper log books are mainly used on the floor to document equipment repairs. The log serves as a communication medium for personnel working in different shifts. A log is maintained for each piece of equipment. For an engineer maintaining a group of machines, access to all the equipment logs becomes cumbersome.

A second source of paper related to equipment is the PM checklist. For every PM procedure performed on equipment, a checklist has to be filled out.

A. Equipment Communication Log

Tools were developed to allow users to maintain equipment logs as part of equipment history within the CAM system. Capability was provided within WORKSTREAM to enter unlimited comments to the history of the machine. An inquiry was developed to view the history of a specific machine or group of machines. The inquiry can filter history data for any *ad hoc* time period. Using this inquiry, a user can obtain the following information:

- products processed on a specific machine;
- comments associated with a machine (example: repair information);
- engineering monitors collected on a machine;
- engineering monitors which violated statistical process control rules.

Fig. 8 illustrates an equipment repair history inquiry.

B. PM Checklist Data

The WORKSTREAM SPEC module is widely used for storing and retrieving process and equipment PM specification. As part of PM specifications, technicians who perform PM's need to fill out a checklist. A checklist includes a sequence of questions regarding the PM being performed. The purpose of a checklist is to ensure completion of a PM procedure and serve as a control and history document for audits. It also drives effective PM's.

In addition to answering questions on the PM performed, engineering data (pressure readings, temperature readings, particle counts, etc.) may have to be gathered. Before the machine is turned over to production, all mandatory steps defined for the checklist must be completed. A technician must be able to view a PM specification to complete the steps in a checklist. For future reference/audit, checklist data have to be retained as part of equipment history.

A new module was developed to meet the requirements of PM checklist data collection. The module allows an engineer to define various steps of a checklist that need to be completed as part of a PM procedure.

How does one interact with the checklist? A technician can walk up to a station and log a transaction to flag the commencement of a PM procedure for an equipment. At this point two things happen. First, the checklist associated with the PM procedure is opened. Second, the scheduler updates the schedule of the corresponding PM.

The technician would then process the steps in a checklist as the PM procedure progresses. The steps can be processed in any order. In practice, a technician may find problems while performing a step (e.g., not able to set a gage to the right value). The technician would identify the step as a *problem* step and associate his comments for future reference.

Engineers can monitor the progress of a checklist at any

FAB X
EQUIPMENT COMMUNICATION LOG

FROM, 6/07/90 14:20:00 TO: 6/14/90 16:00:00

AREA, UTI10

Equipment	Date		Event	Time	User	Comments
UT STEPPER						
SU01	6/13/90	21:52:12	REPAIR DATA	01:19	JOHN	FAILURE MODE :FOCUS ACTION :ADJUSTED SUB-UTSTEPPER :FOCUS SYSTEM SSB-UTSTEPPER :FM SET UP
SU01	6/13/90	21:51:45	BEGIN REPAIR	00:27	SMITH	Ran C cycle. Wafer hold stability and leak check were good.
SU01	6/13/90	17:11:26	TECH AVAIL	4 40:19	SMITH	
SU01	6/13/90	15:57:07	NO TECH	1 14:19	JOE	Needs FM setup up - Focus problem
SU01	6/09/90	23:49:17	BEGIN PM	15:00	JAKE	FAILURE MODE :PM
SU01	6/07/90	16:32:56	REPAIR DATA	00:28	SMITH	FAILURE MODE :AUTO LOADER ACTION :REPLACED SUB-UTSTEPPER :LOAD/UNLOAD SSB-UTSTEPPER :BELTS
SU01	6/07/90	15:55:12	BEGIN REPAIR	00:24	SMITH	FAILURE MODE :AUTO LOADER

Fig. 8. Contents of equipment communication log.

point in time. When the checklist is closed successfully, the checklist steps are stored as part of equipment history. The users have the ability to pull checklist information from the history of equipment. Fig. 9 illustrates a PM checklist during processing.

VII. Equipment Reliability, Availability, Maintainability (ERAM) Analysis

In the earlier sections, the mechanics of gathering equipment failure and performance data via the CAM system were discussed. However, how does the end user get his key indicators on equipment reliability with minimal training and effort? A five man year effort culminated in one such system for the end user. The user can generate plots of key indicators like availability, utilization, MTTR, MTBF, etc. Equipment failure prediction is done using *Weibull* techniques.

A manual system of computing key equipment reliability indicators is very laborious. Many times there is a duplication of effort within the company. The manual system does not adhere to one set of corporate standards, thus making corporate wide analysis of equipment reliability data impossible.

A. Application of Equipment Performance Data

Where does the equipment performance data get used? Several programs like equipment failure prediction, equipment capacity analysis, high output programs, vendor maintenance contracts, day-to-day maintenance planning in factories, etc., need equipment performance data. These data are also required to implement techniques such as failure mode effects and criticality analysis (FMECA) and fault tree analysis (FTA). Through the use of FMECA/FTA techniques, engineers will be able to reduce diagnosis/trouble shooting time and define better PM procedures to prevent failures during the life of the equipment.

B. Analysis Tool Requirements

As the equipment analysis tool is used by a variety of users and for several applications, the tool was designed to meet the following core requirements:

- configuration to be independent of the data-model used in the CAM system to track equipment performance;

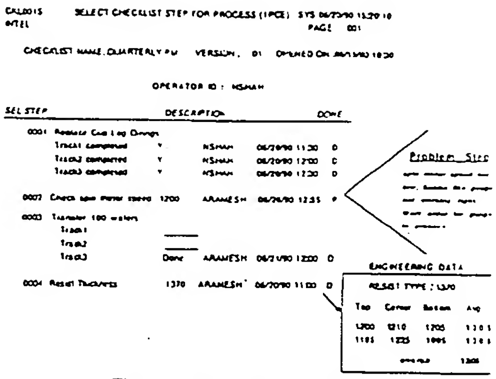

Fig. 9. PM-checklist processing.

- requires minimal training and effort to generate graphs or reports;
- minimal response time to generate a graph or a report;
- ability to view data trends covering more than a year;
- support the industry-standard as defined by the E-10 SEMI document.

C. Data Storage

Equipment performance data are extracted from the CAM system on a weekly basis. These data are further summarized and stored in VAX™ Record Management Services (RMS) files. In the CAM system, each equipment state is named uniquely. Example states are *repair*, *running*, *PM time*, *waiting for vendor*, *etc.* Time is accumulated against each of these states during the course of the equipment usage. The basic states (repair, running, etc.) are further mapped to equipment indicators like *availability*, *utilization*, *scheduled time*, *unscheduled time*, *etc.*

A table is maintained to map the equipment state (running, repair, etc.) to its corresponding equipment performance indicator (producing, scheduled down time, etc.). Table I illustrates one such table. During summarization of the weekly equipment performance data, the table with mappings is referenced for every transaction in the weekly equipment performance data file. This table is vital to enforce one set of standards across the company for reporting equipment RELIABILITY, AVAILABILITY, and MAINTAINABILITY indicators.

D. Semi-Standard

The E-10 specification is a semi-standard for measuring equipment performance. This standard defines six basic equipment indicators as shown in Table I. Each of the equipment states (repair, running, etc.), as defined in the CAM system, is mapped into one of the six E-10 indicators. In partnership with SEMATECH, several standard graphs were developed which comply with the E-10 standard.

The analysis tool can plot the trend of equipment availability, mean time to repair (MTTR), mean wafers between failure (MWBF), mean time between failure (MTBF), etc. Fig. 10–13 illustrates four types of graphs generated from

™VAX is the hardware manufactured by Digital Equipment Corp.

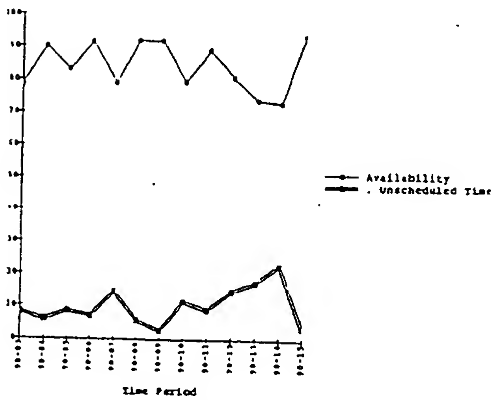

Fig. 10. Equipment availability graph.

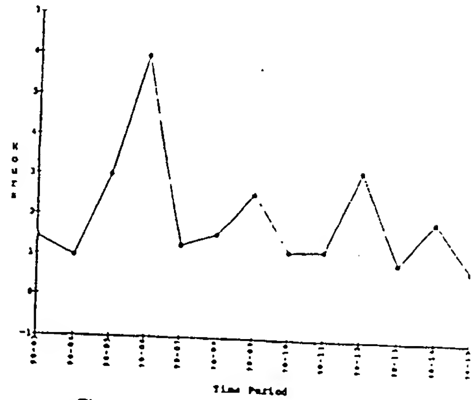

Fig. 12. Equipment MTTR graph.

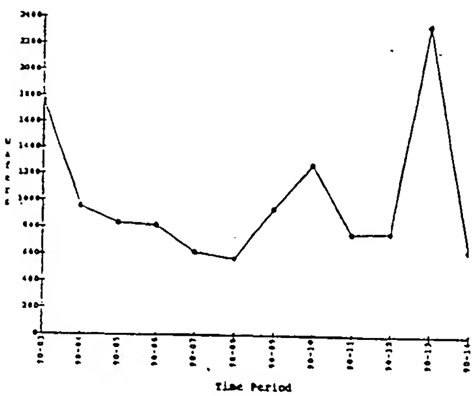

Fig. 11. Equipment MWBF graph.

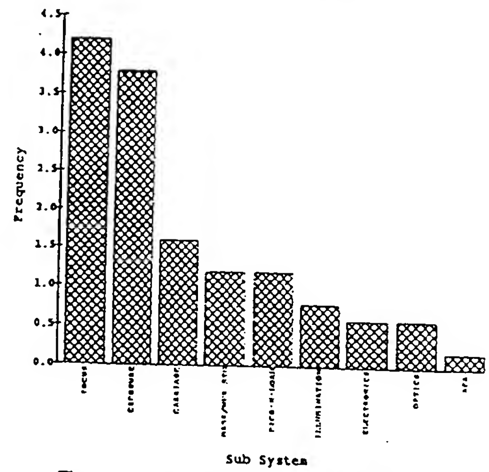

Fig. 13. Equipment subsystem failure graph.

TABLE I
ILLUSTRATION OF E-10 (SEMI-STANDARD) BASIC STATES

EQUIPMENT STATE	PRODUCING	STANDBY	ENG.	SCHEDULED	UNSCHEDULED	NON-SCH.
RUNNING	YES					
NO WIP		YES				
NO OPERATOR		YES				
WAITING MAINT					YES	
REPAIR					YES	
HOLIDAY						YES
TEST WAFER			YES			
MONTHLY PM				YES		

the analysis tool. To allow more granularity for analyzing failure data, engineers are allowed to inquire about the failure frequency of sub-subsystems (bearing, control board, etc.) within a given subsystem (Autoloader).

E. Weibull Analysis

Aerospace companies have widely used *Weibull* analysis for equipment failure prediction. Weibull analysis provides answers to the following questions frequently asked by engineers.

- What are the chances of an equipment subsystem breaking in the next 40 h?
- What is the quality of repairs?
- What is the risk of failure after 30 h of operation?
- How frequently should a PM procedure be done?
- How many spares are required?
- What is the root cause of failure?
  design?
  material quality?
  insufficient testing?

To manually perform *Weibull* analysis, a great deal of time and effort needs to be expended. Several iterations are required before the data are ready to be used in the analysis. By automating the tedious tasks, the analysis has been simpli-

fied. An analysis can now be performed in a couple of minutes. The user interface assumes that the user has no exposure to any statistical tool.

Weibull analysis is performed on the equipment failure data gathered via the CAM system. The most important data required for this analysis are the available time or equipment-usage (number of runs or wafers processed) between each failure of a given subsystem (Autoloader, Indexer).

Analysis is performed in four steps. First, the user is allowed to extract equipment data covering any length of time. Second, the user is allowed to select the failures that need to be part of the analysis. Third, a *Weibull* graph is plotted using a statistical package. Lastly, the user can interpret the *Weibull* graph using the built-in advisor function. A description of the underlying theory of *Weibull* analysis is beyond the scope of this paper.

Characteristic life and slope of the fitted line (beta) are the two key terms used in the analysis. Characteristic life is defined as the point by which 63.2% of the units under study will have failed and 36.8% will remain in service. There are three categories of beta:

1) infant mortality: beta < 1;
2) random failures: beta = 1;
3) wear out: beta > 1;

Using the advisor function on the graph, the user can answer two questions.

1) What percent of parts would fail after a given number of hours or unit of operation?
2) For what length of time or number of units, can a machine be operated before a given percent of parts fail?

Fig. 14 illustrates a *Weibull* plot used to determine frequency of O-ring replacement to minimize both unscheduled downtime and cost. Based on the underlying failure data of the O-ring, we can make the following conclusions:

- inspect O-ring at 40 h;
- change O-ring at 80 h.

IX. Managing Statistical Process Control Violations of Equipment Monitors

To ensure the stable health of the equipment to minimize losses and unscheduled downtime, statistical process control (SPC) techniques have been widely used for equipment monitors. PM's can also be scheduled based on the SPC data as opposed to scheduling them on a fixed interval basis.

A new module integrated with WORKSTREAM was developed to meet the requirements for managing SPC rule violation alarms. This module provides a front end to view all the alarms that have been generated by equipment monitors for a specific equipment or for a group of equipment. Engineers have the capability to write comments to an alarm and finally close the alarm as being resolved. This annotation to the alarm will then be stored as part of the equipment history. One can determine the current status of an alarm by viewing the associated annotations. Such a tool allows engineers to document SPC violations and generate information

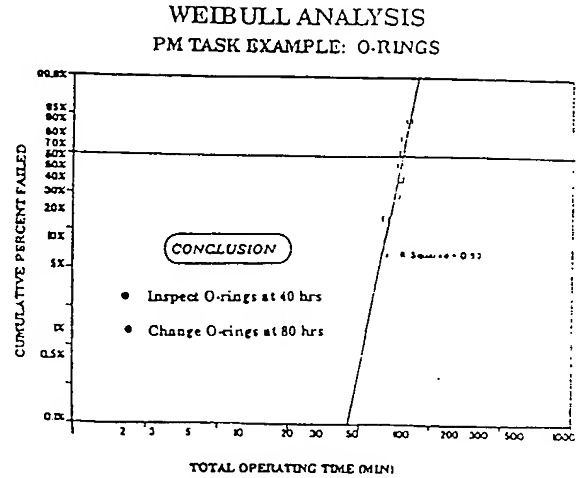

Fig. 14. Example of a Weibull plot.

for customer audits and future reference. Fig. 15 is a graphical illustration of this functionality.

X. Project Implementation

Currently, the equipment management system has been deployed at eight Intel facilities and SEMATECH. The equipment state models to track performance/failure data were different at each facility depending on a facility's maturity and business needs. The needs of startup factories are very different than the needs of mature production factories and development factories.

User groups comprising of operators, technicians, process/equipment engineers, systems analysts, and supervisors were formed to develop an equipment performance tracking model that met factory needs. Flexible tools developed by Consilium and Intel were used to make this model as close to the real world as possible. Usage of the system and completeness of the data is ensured when a system can mirror the real world needs. All tools developed have been successful and are being used extensively.

XI. Integration with External Systems

Intel has introduced various automation products into its factories. The biggest challenge is to integrate all the products together. The automation products include expert systems, automated material handling systems, and station controllers.

Equipment downtime data that are being collected manually by the operator can now be automatically collected by the station controller through the machine-interface software. Where should equipment management reside? At the station controller or the host system? These are some of the questions we are currently trying to answer. Expert systems hold promise as an excellent tool for troubleshooting equipment failures. Combining features of the expert system and the equipment performance system to get the best results is another integration task.

XII. Conclusion

To drive high equipment reliability/utilization in manufacturing, a comprehensive equipment information management

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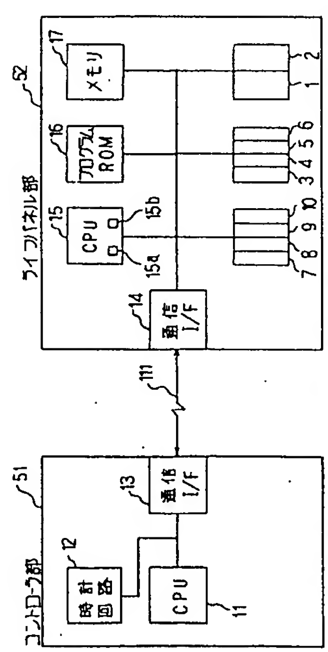
(71)出願人　000006013
三菱電機株式会社
東京都千代田区丸の内二丁目２番３号
(72)発明者　平松　伸一
神戸市兵庫区和田崎町１丁目１番２号　三菱電機株式会社制御製作所内
(74)代理人　弁理士　宮園　純一

(54)【発明の名称】　プロセスコントローラ及びデータ監視方法

(57)【要約】

【目的】　プロセスコントローラの寿命部品の交換時期を自動的に監視することにより故障を未然に防止し、更に、保守点検作業の簡略化及び時間短縮が図れるプロセスコントローラを得る。

【構成】　プロセスコントローラの寿命を有する構成部品の使用開始日と交換周期は設定スイッチ９により設定され、使用開始日表示器４と交換周期表示器６にそれぞれ表示される。使用開始日から現在に至るまでの稼働期間は計算手段１５ａにより計算され、稼働期間表示器５に表示される。稼働期間が交換周期を過ぎると、警告信号出力手段１５ｂより警告信号が出力される。



1；部品選択表示器，2；部品寿命警告表示器，3；現在日表示器，4；使用開始日表示器，5；稼働期間表示器，6；交換周期表示器，7；部品選択スイッチ，8；設定項目選択スイッチ，9；設定スイッチ，10；設定データ変更スイッチ，15a；計算手段，15b；警告信号出力手段，111；通信線

【特許請求の範囲】

【請求項１】　制御対象を制御するプロセスコントローラにおいて、寿命を有する構成部品の使用開始日や交換周期を設定できる設定手段と、上記使用開始日から現在に至るまでの稼働期間を計算する計算手段と、上記稼働期間が上記交換周期を過ぎると警告信号を出力する警告信号出力手段と、上記使用開始日や上記稼働期間や上記交換周期等の部品寿命データを表示する部品寿命データ表示手段とを備えたことを特徴とするプロセスコントローラ。

【請求項２】　制御対象を制御するプロセスコントローラと上位マンマシン監視装置とを接続し、上記プロセスコントローラにおいて生成された部品寿命データを上記上位マンマシン監視装置でも監視可能にしたことを特徴とするデータ監視方法。

【請求項３】　制御対象を制御するプロセスコントローラと電話回線とを接続し、上記プロセスコントローラにおいて生成された部品寿命データを電話機やファクシミリでも監視可能にしたことを特徴とするデータ監視方法。

【請求項４】　制御対象を制御するプロセスコントローラとプログラム作成ツールとを接続し、上記プロセスコントローラにおいて生成された部品寿命データを上記プログラム作成ツールでも監視可能にしたことを特徴とするデータ監視方法。

【請求項５】　制御対象を制御するプロセスコントローラにおいて、寿命を有する構成部品の使用開始日や交換周期を設定できる設定手段と、上記使用開始日から現在に至るまでの稼働期間を計算する計算手段と、上記稼働期間が上記交換周期を過ぎると警告信号を出力する警告信号出力手段と、上記使用開始日や上記稼働期間や上記交換周期等の部品寿命データを表示する部品寿命データ表示手段と、上記部品寿命データを蓄える部品交換履歴リストファイルとを備えたことを特徴とするプロセスコントローラ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、プラント等を制御する計装制御システムに適用されるプロセスコントローラ及びデータ監視方法に関するものである。

【０００２】

【従来の技術】図１０は、例えば三菱総合計装制御システム　ＭＡＣＴＵＳ５３０　保守点検要領書（ＩＢ－６２５２７－Ａ，１９９３年６月発行）に示された計装制御システムにおける従来のプロセスコントローラの稼働状況を運転員に示すためのモニターパネルであり、図１１は、このプロセスコントローラの概略斜視図である。図１０において、２５～２９がプロセスコントローラの状態を示す各ＬＥＤ表示器であり、詳しくは２５は重故障ＬＥＤ表示器、２６は軽故障ＬＥＤ表示器、２７はＣＰＵ電源異常ＬＥＤ表示器、２８はＩＯ電源異常ＬＥＤ表示器、２９はバッテリ低下ＬＥＤ表示器を示す。又、３０は重故障の要因を示す論理図、３１は軽故障の要因を示す論理図を描いたものである。

【０００３】次に動作について説明する。プロセスコントローラの運転員は、計装制御システムが正常であるか異常が発生していないかを重故障ＬＥＤ表示器２５及び軽故障ＬＥＤ表示器２６をモニターして判断する。各ＬＥＤ表示器２５～２９は正常で点灯し、異常で消灯する。

【０００４】重故障ＬＥＤ表示器２５が消灯している場合、プロセスコントローラに重故障が発生しているものと判断する。次に、重故障が発生している要因を論理図３０によりたどり異常部位を特定する。例えば、ＣＰＵ電源ＬＥＤ表示器２７及びＩＯ電源ＬＥＤ表示器２８が消灯している場合、ＣＰＵ電源の異常及びＩＯ電源の異常の発生によりシステム重故障が発生しているものと異常部位を判断できる。次に、プロセスコントローラを停止させ、故障したＣＰＵ電源及びＩＯ電源の装置の交換を行ない、計装制御システムを復旧させる。

【０００５】同様に、軽故障ＬＥＤ表示器２６が消灯している場合、プロセスコントローラに軽故障が発生しているものと判断し、軽故障が発生している要因を論理図３１によりたどり異常部位を特定する。例えば、バッテリ低下ＬＥＤ表示器２９が消灯している場合、バッテリが低下しているので新しいバッテリと交換が必要である。

【０００６】

【発明が解決しようとする課題】従来のプロセスコントローラのモニターパネルは以上のように構成されているので、各部品が正常か異常かの判断は可能であるが、モニターパネルを確認しただけでは、その部品に寿命が来ており交換を要するかどうかまでは判断できず、別途、運転員が定期的に部品交換表を作成することが必要であり、それにより部品交換時期を確認しなければならない不便さがあった。

【０００７】この発明は上記のような課題を解決するためになされたものであり、プロセスコントローラの寿命部品の交換時期を自動的に監視することにより故障を未然に防止し、更に、保守点検作業の簡略化及び時間短縮が図れるプロセスコントローラを得ることを目的とする。

【０００８】

【課題を解決するための手段】第１の発明に係るプロセスコントローラは、寿命を有する構成部品の使用開始日や交換周期を設定できる設定手段（設定スイッチ９）と、上記使用開始日から現在に至るまでの稼働期間を計算する計算手段１５ａと、上記稼働期間が上記交換周期を過ぎると警告信号を出力する警告信号出力手段１５ｂと、上記使用開始日や上記稼働期間や上記交換周期等の

部品寿命データを表示する部品寿命データ表示手段（使用開始日表示器４、稼働期間表示器５、交換周期表示器６）とを備えたことを特徴とするものである。

【０００９】第２の発明に係るデータ監視方法は、制御対象を制御するプロセスコントローラＰと上位マンマシン監視装置１８とを接続し、上記プロセスコントローラＰにおいて生成された部品寿命データを上記上位マンマシン監視装置１８でも監視可能にしたことを特徴とするものである。

【００１０】第３の発明に係るデータ監視方法は、制御対象を制御するプロセスコントローラＰと電話回線９５とを接続し、上記プロセスコントローラＰにおいて生成された部品寿命データを電話機９２やファクシミリ９３でも監視可能にしたことを特徴とするものである。

【００１１】第４の発明に係るデータ監視方法は、制御対象を制御するプロセスコントローラＰとプログラム作成ツール２０とを接続し、上記プロセスコントローラＰにおいて生成された部品寿命データを上記プログラム作成ツール２０でも監視可能にしたことを特徴とするものである。

【００１２】第５の発明に係るプロセスコントローラは、寿命を有する構成部品の使用開始日や交換周期を設定できる設定手段（設定スイッチ９）と、上記使用開始日から現在に至るまでの稼働期間を計算する計算手段１５ａと、上記稼働期間が上記交換周期を過ぎると警告信号を出力する警告信号出力手段１５ｂと、上記使用開始日や上記稼働期間や上記交換周期等の部品寿命データを表示する部品寿命データ表示手段（使用開始日表示器４、稼働期間表示器５、交換周期表示器６）と、上記部品寿命データを蓄える部品交換履歴リストファイル２３とを備えたことを特徴とするものである。

【００１３】

【作用】第１の発明に係るプロセスコントローラにおいては、寿命を有する構成部品の使用開始日や交換周期が設定手段（設定スイッチ９）により設定され、使用開始日から現在に至るまでの稼働期間が計算手段１５ａにより計算される。また、使用開始日と交換周期と稼働期間は部品寿命データ表示手段（使用開始日表示器４、交換周期表示器６、稼働期間表示器５）に表示される。稼働期間が交換周期を過ぎると、警告信号出力手段１５ｂから警告信号が出力される。

【００１４】第２の発明に係るデータ監視方法においては、プロセスコントローラＰで生成された部品寿命データは上位マンマシン監視装置１８に送られ、上位マンマシン監視装置１８でも監視可能となる。

【００１５】第３の発明に係るデータ監視方法においては、プロセスコントローラＰで生成された部品寿命データは電話回線９５を介して電話機９２やファクシミリ９３に送られる。これにより電話機９２やファクシミリ９３でも部品寿命データが監視可能となる。

【００１６】第４の発明に係るデータ監視方法においては、プロセスコントローラＰで生成された部品寿命データはプログラム作成ツール２０に送られ、プログラム作成ツール２０でも監視可能となる。

【００１７】第５の発明に係るプロセスコントローラにおいては、寿命を有する構成部品の使用開始日や交換周期が設定手段（設定スイッチ９）により設定され、使用開始日から現在に至るまでの稼働期間が計算手段１５ａにより計算される。また、使用開始日と交換周期と稼働期間は部品寿命データ表示手段（使用開始日表示器４、交換周期表示器６、稼働期間表示器５）に表示される。稼働期間が交換周期を過ぎると、警告信号出力手段１５ｂから警告信号が出力される。また、部品寿命データは部品交換履歴リストファイル２３に蓄えられる。

【００１８】

【実施例】

実施例１．以下、この発明の実施例１を図に基づいて説明する。図１はこの発明の実施例１に係るプロセスコントローラの構成を示すブロック図である。図１において、コントローラ部５１はＣＰＵ１１、時計回路１２、及び通信インタフェース（通信Ｉ／Ｆ）１３を備えている。ライフパネル部５２は、通信インタフェース１４、ＣＰＵ１５、プログラムＲＯＭ１６、メモリ１７、部品選択表示器１、部品寿命警告表示器２、現在日表示器３、使用開始日表示器（部品寿命データ表示手段）４、稼働期間表示器（部品寿命データ表示手段）５、交換周期表示器（部品寿命データ表示手段）６、部品選択スイッチ７、設定項目選択スイッチ８、設定スイッチ（設定手段）９、及び設定データ変更スイッチ１０を備えている。なお、上記表示器１，２はＬＥＤで実現され、上記表示器３～６は英数字ＬＥＤで実現される。コントローラ部５１とライフパネル部５２は通信線１１１を介して接続されている。上記ライフパネル部５２内の設定スイッチ９は、本プロセスコントローラに備えられる図示しない電源装置、ファン、フィルタ、バッテリ等のような特に寿命がある部品の使用開始日や交換周期を設定できる設定手段である。また、ＣＰＵ１５は、部品の使用開始日から現在に至るまでの稼働期間を計算する計算手段１５ａと、上記稼働期間が上記交換周期を過ぎると警告信号を出力する警告信号出力手段１５ｂとを備えている。図２は上記ライフパネル部５２における表示パネル５３の概略外観図である。この表示パネル５３は、上述したように、部品選択表示器１、部品寿命警告表示器２、現在日表示器３、使用開始日表示器４、稼働期間表示器５、交換周期表示器６、部品選択スイッチ７、設定項目選択スイッチ８、設定スイッチ９、及び設定データ変更スイッチ１０を備えている。

【００１９】図１に示すライフパネル部５２におけるＣＰＵ１５は、部品選択表示器１、部品寿命警告表示器２、現在日表示器３、使用開始日表示器４、稼働期間表

示器５、交換周期表示器６、部品選択スイッチ７、設定項目選択スイッチ８、設定スイッチ９、及び設定データ変更スイッチ１０を制御する。プログラムＲＯＭ１６はＣＰＵ１５が制御を行うためのプログラムを記憶している。メモリ１７は、部品の使用開始日、稼働期間、交換周期などの記憶を行う。ライフパネル部５２が現在日を認識するために、通信インタフェース１３，１４及び通信線１１１を介してコントローラ部５１のＣＰＵ１１と通信し、コントローラ部５１の時計回路１２の時刻を読み出す。

【００２０】次に図２の表示パネル５３の表示内容、操作方法について説明する。プロセスコントローラにおいて寿命を確認したい部品を部品選択スイッチ７により選択する。現在、選択されている部品は、該当の部品選択表示器１が点灯する。その部品の使用開始日、稼働期間はそれぞれ使用開始日表示器４、稼働期間表示器５に表示される。稼働期間表示器５に表示される稼働期間は、現在日表示器３に表示される現在日から使用開始日表示器４に表示される使用開始日を引いたものであり、その部品はどれだけ使用されているかが確認できる。また、その部品の交換周期は、交換周期表示器６に表示される。稼働期間表示器５と交換周期表示器６の表示内容により、あとどれだけその部品が使用できるか判断できる。稼働期間は計算手段１５ａにより計算され、稼働期間表示器５に表示された稼働期間が交換周期表示器６に表示された交換周期を越えると、部品の交換時期であり、警告信号出力手段１５ｂからの警告信号により部品寿命警告表示器２が点灯し、部品の交換時期を運転員に知らせる。現在日表示器３、使用開始日表示器４、交換周期表示器６の内容は寿命表示パネル上で変更することができる。変更方法は、変更したい項目を設定項目選択スイッチ８で選択し、設定データ変更スイッチ１０でデータの数値を変更する。変更後、設定スイッチ９を押すことにより変更された内容が登録される。

【００２１】次にライフパネル部５２のＣＰＵ１５の動作を図３～図５に示すフローチャートで説明する。先ず、図３のフローチャートは部品寿命警告表示器２の表示処理について示したものである。ライフパネル部５２のＣＰＵ１５は、コントローラ部５１の時計回路１２の時刻を通信インタフェース１４を通して読み出し、現在日を認識する（ステップＳＴ１）。次に使用開始日をメモリ１７により読み出す（ステップＳＴ２）。そして現在日から使用開始日を引き、稼働期間を計算しメモリ１７に記憶する（ステップＳＴ３）。その後、交換周期をメモリ１７より読み出し、稼働期間と比較する（ステップＳＴ４）。稼働期間が交換周期を越えた場合は、部品寿命警告表示器２を点灯させる（ステップＳＴ５）。このようなステップＳＴ２からステップＳＴ５の処理を全部品分行う（ステップＳＴ６）。

【００２２】次に、図４のフローチャートは現在日、使用開始日、交換周期の設定変更処理を示したものである。まず、現在日の変更が有ったかどうかを確認し（ステップＳＴ７）、変更が有った場合は、コントローラ部５１の時計回路１２の時刻１２を修正する（ステップＳＴ８）。次に部品選択スイッチ７により現在選択されている部品を認識しておく（ステップＳＴ９）。そして、使用開始日、交換周期が変更されたかどうか確認し（ステップＳＴ１０、ステップＳＴ１２）、変更が有った場合は、メモリ１７に記憶されている内容である使用開始日、交換周期を変更する（ステップＳＴ１１、ステップＳＴ１３）。

【００２３】次に、図５のフローチャートは各表示器３～６の表示処理について示したものである。現在日表示器３は、コントローラ部５１の時計回路１２の時刻を読み出し表示する（ステップＳＴ１４）。使用開始日表示器４、稼働期間表示器５、及び交換周期表示器６の使用開始日、稼働期間、及び交換周期の表示は、部品選択スイッチ７により現在選択されている部品を認識しておき（ステップＳＴ１５）、該当部品の内容をメモリ１７より読み出すことによって行われる（ステップＳＴ１６）。

【００２４】実施例２．なお、上記実施例１の表示パネル５３では、ＬＥＤの表示器１，２、英数字ＬＥＤの表示器３～６、スイッチ７～１０を用いて構成したが、本実施例２では、図６に示すように液晶タッチパネルディスプレイ装置６１を用いて構成するようにしてもよく、これにより更に小形化することができ、上記実施例１と同様の効果を奏する。

【００２５】実施例３．また、上記実施例１，２では、プロセスコントローラのライフパネル部まで運転員が行って部品の寿命確認を行わなければいけなかったが、ライフパネル部で記憶している各部品の寿命データを、図７に示すようにシステムバス７１経由で上位マンマシン監視装置１８に各プロセスコントローラＰ１～Ｐｎの寿命部品状態を表示させたり、電話回線７４を利用して運転員が常駐している場所の電話機７２やＦＡＸ（ファクシミリ）１９を自動的に鳴らし寿命がきたことを通報するようにしたので、遠隔地にいながらプロセスコントローラＰ１～Ｐｎの寿命部品の監視が行えるようになる。又、プロセスコントローラＰ１～Ｐｎのプログラム作成ツール２０にも通信インタフェース７５経由で寿命表示するようにしたので、プロセスコントローラＰ１～Ｐｎの調整をしながらでも監視することができる。

【００２６】実施例４．更に、上記実施例１，２，３では、寿命表示だけであったが、本実施例４のように上位マンマシン監視装置やプログラム作成ツールに接続されるプリンタに過去の部品交換履歴をリストアウトすれば、ドキュメントとして残せることができる。

【００２７】図８はこの発明の実施例４に係るプロセスコントローラを含むシステムの構成を示すブロック図で

ある。図8において、図1に示す構成要素に相当するものには同一の符号を付し、その説明を省略する。図8において、プロセスコントローラPのコントローラ部51は、実施例1と同様、CPU11、時計回路12、通信インタフェース13の他に、ライフパネル部52で生成された部品寿命データを蓄える部品交換履歴ファイル23、上位マンマシン監視装置18とのインタフェースを司るシステムバスインタフェース82、電話機92やファクシミリ93を接続した電話回線95とのインタフェースを司る電話回線インタフェース81、及びプログラム作成ツール20とのインタフェースを司るプログラム作成ツールインタフェース83を備えている。上位マンマシン監視装置18は、コントローラ部51とのインタフェースを司るシステムバスインタフェース84、コントローラ部51から送られてきた部品寿命データを蓄える部品交換履歴ファイル24、CRT90とのインタフェースを司るCRTインタフェース86、キーボード91とのインタフェースを司るキーボードインタフェース87、プリンタ21とのインタフェースを司るプリンタインタフェース88、及び上記構成要素を制御するCPU85を備えている。上位マンマシン監視装置18とコントローラ部51とはシステムバス94で接続されている。プログラム作成ツール20にはプリンタ22が接続されている。

【0028】次に動作について説明する。ライフパネル部52にて部品交換された内容は、その都度、通信インタフェース14、通信線111、及び通信インタフェース13を経由してコントローラ部51内の部品交換履歴ファイル23に例えば図9に示すような部品交換履歴リストとして蓄えられる。また、上位マンマシン監視装置18の部品交換履歴ファイル24にも、システムバスインタフェース82、システムバス94、及びシステムバスインタフェース84を経由して部品寿命データが部品交換履歴リストとして蓄えられる。コントローラ部51の部品交換履歴ファイル23に蓄えられた部品寿命データをプログラム作成ツール20に送ると、プリンタ22により部品交換履歴リストを印字出力できる。また、その部品寿命データを電話機92に送ると、警報を発生させることができたり、その部品寿命データをファクシミリ93に送ると、その部品交換履歴リストを印字出力できる。また、上位マンマシン監視装置18の部品交換履歴ファイル24に蓄えられた部品寿命データをプリンタ21に送ると、その部品交換履歴リストを印字出力できる。更に、部品交換履歴ファイル24の内容をCRT90に表示できるので、キーボード91の操作により、その内容を修正できる。本実施例4のように部品交換履歴リストを自動生成できるので、運転員の保守点検が容易になり時間短縮される。

【0029】

【発明の効果】以上のように第1の発明によれば、寿命を有する構成部品の使用開始日や交換周期を設定できる設定手段と、上記使用開始日から現在に至るまでの稼働期間を計算する計算手段と、上記稼働期間が上記交換周期を過ぎると警告信号を出力する警告信号出力手段と、上記使用開始日や上記稼働期間や上記交換周期等の部品寿命データを表示する部品寿命データ表示手段とを備えて構成したので、プロセスコントローラの寿命部品の交換時期を自動的に知らせることができ、また、寿命部品の交換時期を容易に確認することができ、これにより故障を未然に防止できるという効果が得られる。また、保守点検作業の簡略化及び時間短縮が図れるという効果が得られる。

【0030】第2の発明によれば、制御対象を制御するプロセスコントローラと上位マンマシン監視装置とを接続し、上記プロセスコントローラにおいて生成された部品寿命データを上記上位マンマシン監視装置でも監視可能にしたので、中央監視室にいながらプロセスコントローラの寿命部品の交換時期を監視することができ、これにより故障を未然に防止でき、保守点検作業の簡略化及び時間短縮が図れるという効果が得られる。

【0031】第3の発明によれば、制御対象を制御するプロセスコントローラと電話回線とを接続し、上記プロセスコントローラにおいて生成された部品寿命データを電話機やファクシミリでも監視可能にしたので、遠隔地にいながらプロセスコントローラの寿命部品の交換時期を監視することができ、これにより故障を未然に防止でき、保守点検作業の簡略化及び時間短縮が図れるという効果が得られる。

【0032】第4の発明によれば、制御対象を制御するプロセスコントローラとプログラム作成ツールとを接続し、上記プロセスコントローラにおいて生成された部品寿命データを上記プログラム作成ツールでも監視可能にしたので、プロセスコントローラを調節しながら寿命部品の交換時期を監視することができ、これにより故障を未然に防止でき、保守点検作業の簡略化及び時間短縮が図れるという効果が得られる。

【0033】第5の発明によれば、第1の発明を構成する設定手段、計算手段、警告信号出力手段、部品寿命データ表示手段の他に、部品寿命データを蓄える部品交換履歴リストファイルも備えて構成したので、第1の発明と同様な効果が得られるとともに、部品交換履歴リストも出力することが可能となり、保守点検作業を更に容易に短時間で行えるという効果も得られる。

【図面の簡単な説明】

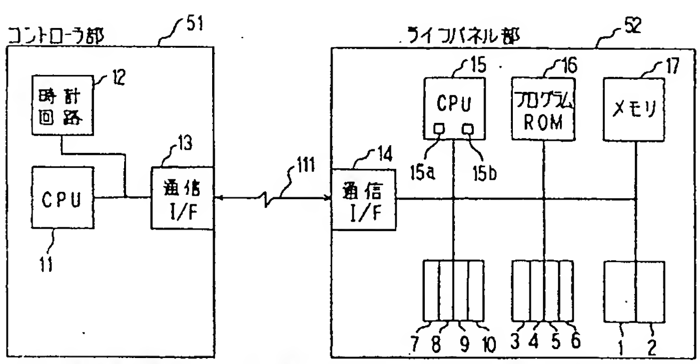
【図1】　この発明の実施例1に係るプロセスコントローラの構成を示すブロック図である。

【図2】　実施例1における表示パネルを示す図である。

【図3】　実施例1における寿命警告出力処理を示すフローチャートである。

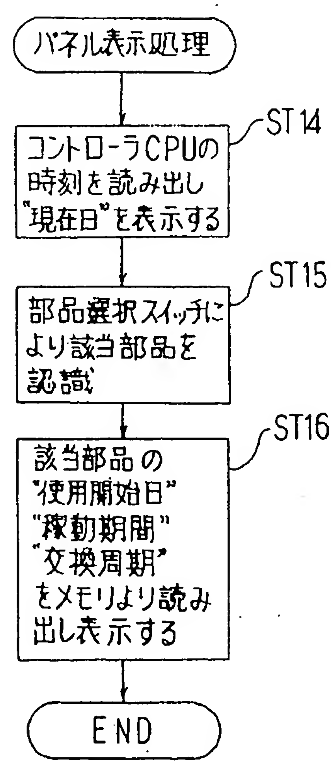
【図4】 実施例1における設定変更処理を示すフローチャートである。
【図5】 実施例1におけるパネル表示処理を示すフローチャートである。
【図6】 この発明の実施例2における液晶タッチパネルディスプレイ装置の外観図である。
【図7】 この発明の実施例3に係るプロセスコントローラを含むシステムの構成図である。
【図8】 この発明の実施例4に係るプロセスコントローラを含むシステムの構成を示すブロック図である。
【図9】 実施例4における部品交換履歴リストを示す図である。
【図10】 従来のプロセスコントローラのモニターパネルを示す図である。
【図11】 従来のプロセスコントローラの概略斜視図である。
【符号の説明】
1 部品選択表示器、2 部品寿命警告表示器、3 現在日表示器、4 使用開始日表示器（部品寿命データ表示手段）、5 稼働期間表示器（部品寿命データ表示手段）、6 交換周期表示器（部品寿命データ表示手段）、7 部品選択スイッチ、8 設定項目選択スイッチ、9 設定スイッチ（設定手段）、10 設定データ変更スイッチ、11，15，85 CPU、12 時計回路、13，14，75 通信インタフェース、16 プログラムROM、17 メモリ、18 上位マンマシン監視装置、20 プログラム作成ツール、21，22 プリンタ、23，24 部品交換履歴ファイル、25 重故障LED表示器、26 軽故障LED表示器、27 CPU電源LED表示器、28 IO電源LED表示器、29 バッテリ低下LED表示器、30 重故障ロジック図、31 軽故障ロジック図、51 コントローラ部、52 ライフパネル部、53 表示パネル、61 液晶タッチパネルディスプレイ装置、P，P1，Pn プロセスコントローラ、71，94 システムバス、72，92 電話機、73，93 ファクシミリ、74 電話回線、81 電話回線インタフェース、82，84 システムバスインタフェース、83 プログラム作成ツールインタフェース、86 CRTインタフェース、87 キーボードインタフェース、88 プリンタインタフェース、90 CRT、91 キーボード、111 通信線。

【図1】

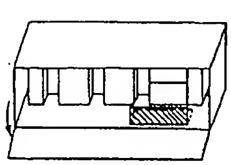


1; 部品選択表示器、2; 部品寿命警告表示器、3; 現在日表示器、4; 使用開始日表示器、5; 稼働期間表示器、6; 交換周期表示器、7; 部品選択スイッチ、8; 設定項目選択スイッチ、9; 設定スイッチ、10; 設定データ変更スイッチ、15a; 計算手段、15b; 警告信号出力手段、111; 通信線

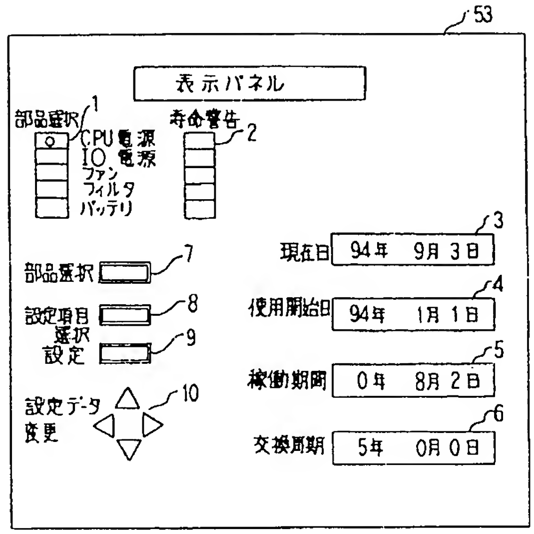
【図5】



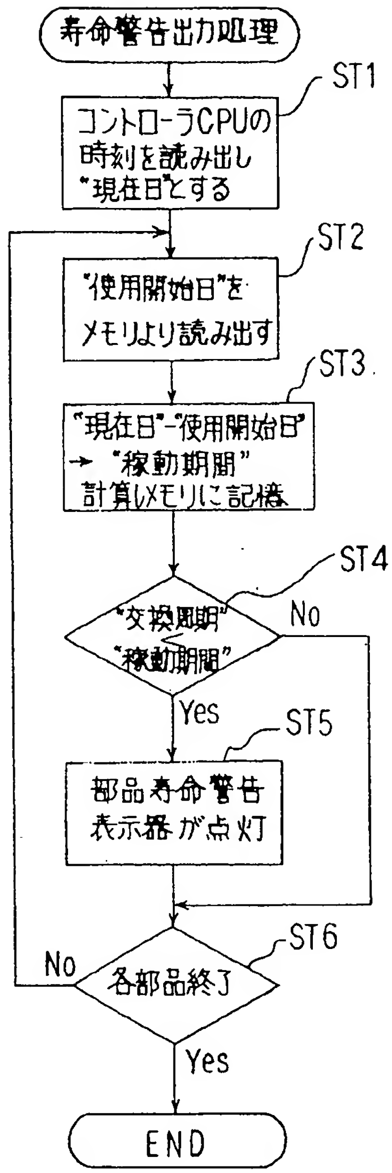
【図11】



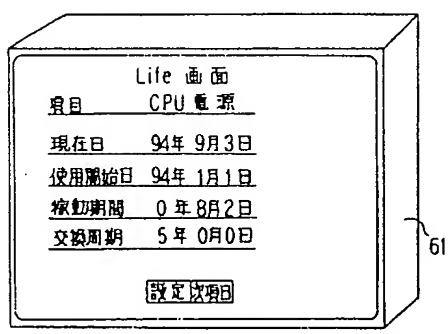
【図2】



【図3】

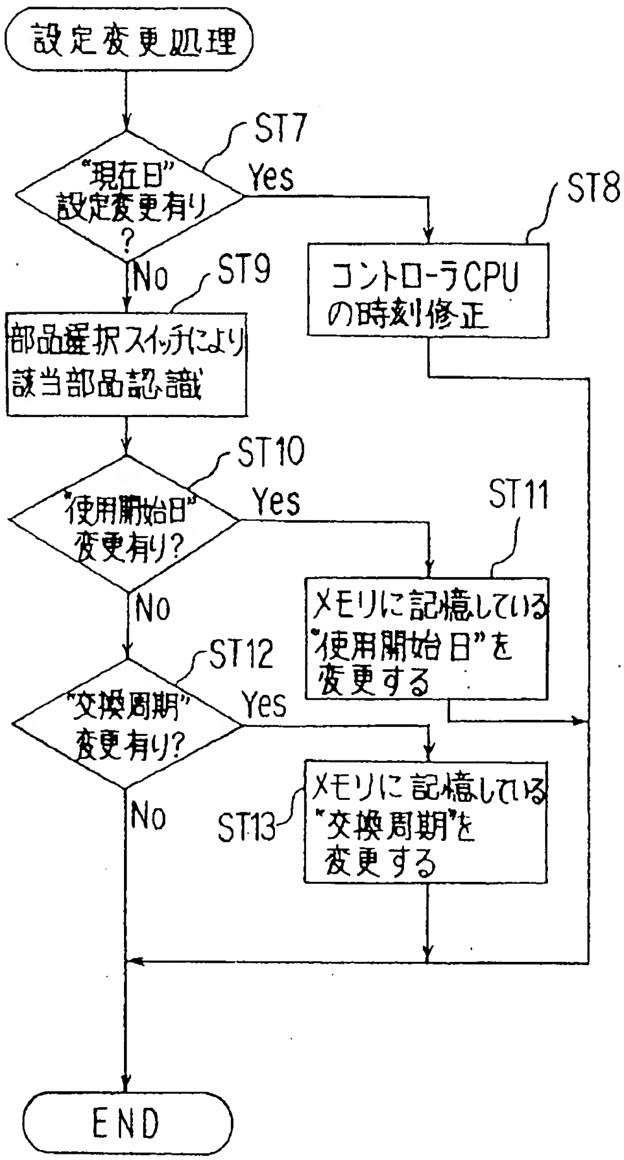


【図6】

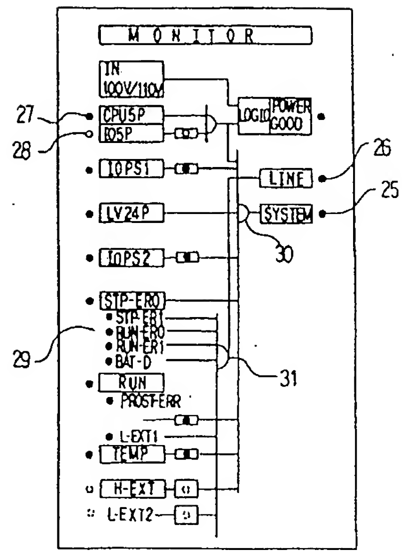


液晶タッチパネルディスプレイ装置

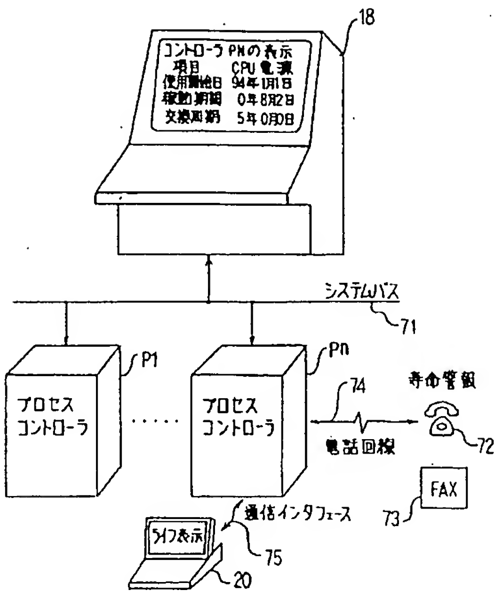
【図4】


設定変更処理
"現在日"設定変更有り？
ST7
Yes
No
ST8
コントローラCPUの時刻修正
ST9
部品選択スイッチにより該当部品認識
ST10
"使用開始日"変更有り？
Yes
No
ST11
メモリに記憶している"使用開始日"を変更する
ST12
"交換周期"変更有り？
Yes
No
ST13
メモリに記憶している"交換周期"を変更する
END

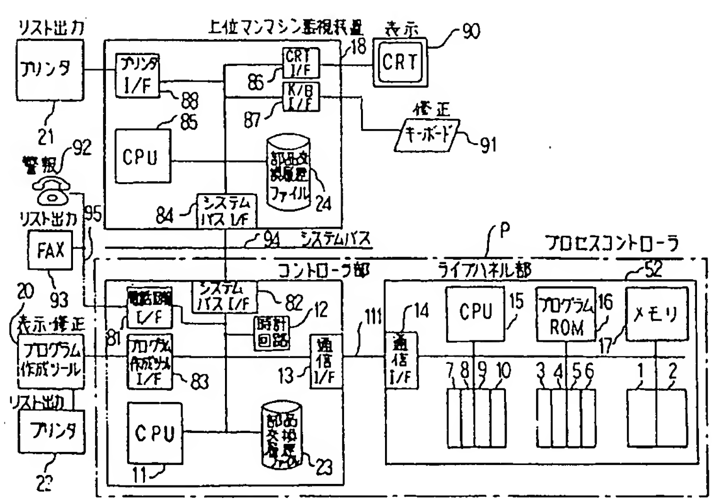
【図10】


MONITOR
IN 100V/110V
CPU5P
IO5P
LOGIC
POWER GOOD
IOPS1
LINE
LV24P
SYSTEM
IOPS2
STP-ER0
STP-ER1
RUN-ER0
RUN-ER1
BAT-D
RUN
PROST-ERR
L-EXT1
TEMP
H-EXT
L-EXT2
27
28
26
25
30
29
31

【図7】


コントローラ PNの表示
項目 CPU電源
使用開始日 94年1月1日
稼動期間 0年8月2日
交換周期 5年0月0日
18
システムバス
71
P1
Pn
プロセス
コントローラ
プロセス
コントローラ
74
寿命警報
電話回線
72
FAX
73
通信インタフェース
ライフ表示
75
20
18；上位マンマシン監視装置
20；プログラム作成ツール

【図8】


リスト出力
プリンタ
21
上位マンマシン監視装置
表示
CRT
90
18
プリンタ I/F
88
CRT I/F
86
K/B I/F
87
修正
キーボード
91
CPU
85
部品交換履歴ファイル
24
警報
92
システムバス I/F
84
リスト出力
95
FAX
93
94 システムバス
P
プロセスコントローラ
コントローラ部
ライフハネル部
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【図9】

プロセスコントローラPn

部品交換履歴リスト

作成	照査	検認

交換日	寿命部品				
	CPU電源	IO電源	ファン	フィルター	バッテリー
89年4月1日	―	―	―	―	1
90年4月5日	―	―	1	1	2
91年4月15日	―	―	―	―	3
92年4月13日	―	―	2	2	4
93年4月2日	1	1	―	―	5
94年4月17日	―	―	3	3	6

※表中の数値は交換した回数の積算値，－は交換していないことを示す

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